POWER TRANSMISSION DESIGN

NOVEMBER 1961

INCLUDING BEARING DESIGN/APPLICATION

STEVENS RICE
UNIVERSITY-MICROFILMS
313 N FIRST ST
ANN ARBOR MICH

Bearing Location Can Cost Less

PAGE 40

PTD / SPECIAL REPORT:

Maintain Your Electrical Controls

PAGE 27

PART 3:

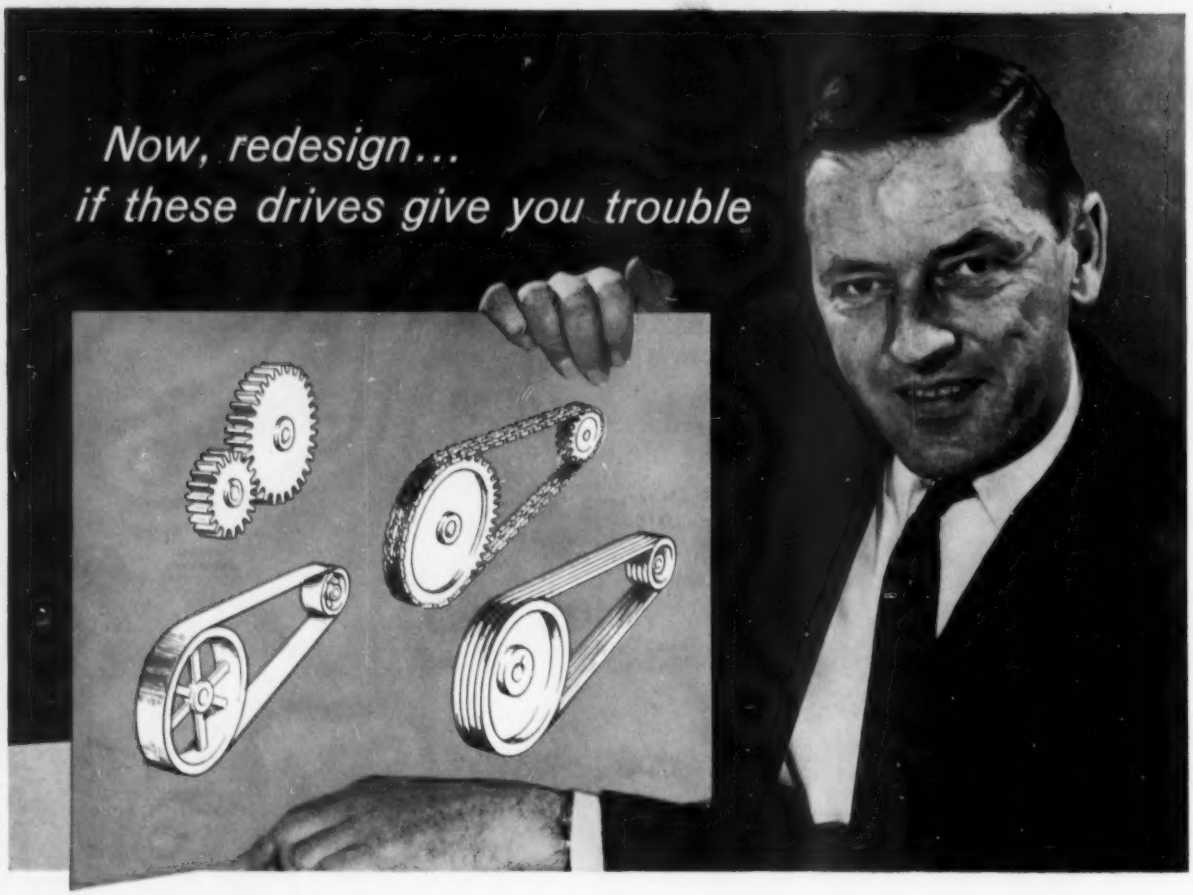
TORSIONAL VIBRATION

PAGE 25

How to design shafts for machine drives

PAGE 19

The specialized magazine for the power transmission market—design and application for OEM and in-plant equipment



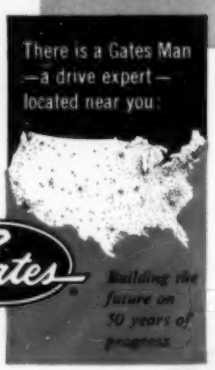
Ask your local Gates Man to show you how Super HC Drives reduce machine down-time

If you have a chain, gear, flat belt or even a conventional V-belt drive that is causing costly production down-time or high maintenance costs, your local Gates Man will be glad to help you. He will show you how these troubles can be ended by using a Gates Super HC V-Belt Drive—the first and most advanced High Capacity drive.

Because of exclusive design features, Gates Super HC V-Belts handle up to 3 times the horsepower of conventional V-belts in the same space—or they can often handle the required horsepower in about half the space. Fewer belts are needed, and sheaves can be smaller and lighter weight. As a result, bearing loads are less, increasing bearing life, reducing maintenance costs.

Gates Super HC Drive is quiet, smooth-running and entirely dependable—multiple belts assure you of continuous operation, ending costly production losses. It is a highly resilient drive that protects your machine from vibration and damaging shock loads, increasing machine life and lowering maintenance costs—savings that often amount to many times the cost of the drive.

The Gates Man located near you is a drive design expert. Ask your nearby Gates Distributor for his help when you have a drive problem.



BP 41

The Gates Rubber Company, Denver, Colorado

Gates

Gates Super HC V-Belt Drives

Circle **18** on Reader Service Card

maurey
positive drives

give you three mighty advantages

1 SMOOTH, SLIP-PROOF POWER TRANSMISSION

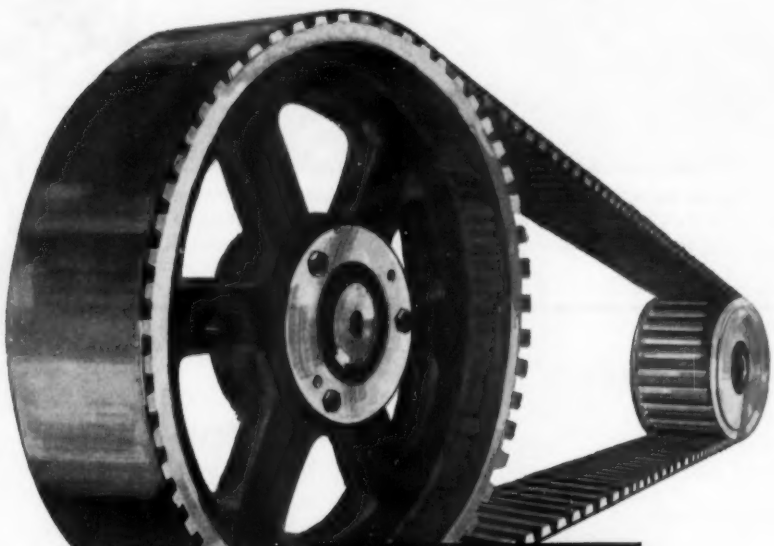
With belt teeth meshed in pulley grooves, Maurey Positive Drives are slip-proof as chain and gear drives. Maximum power moves to work smoothly, quietly, with uniform speed. There is no rise and fall of pitch line, no slippage, no creeping, no backlash. Here, in brief, is smooth, positive power transmission on heavy loads or the finest precision work.

2 WIDE RANGE OF SPEED AND HORSEPOWER IN COMPACT SIZE

From fractional horsepower to 600 h.p., Maurey Positive Drives are proven drives. Their normal belt speeds range from 100 fpm to 10,000 fpm. Belts and pulleys combine maximum horsepower with minimum space. This inherent compactness is a vital advantage to the designer facing weight and space limitations.

3 LOW COST POWER TRANSMISSION

Since the Maurey Positive Drive does not rely on friction, high initial belt tension is not needed. That means minimum bearing load all the time, and low heat build-up while the drive runs. With no metal-to-metal contact, there is no need of lubricating systems. Adjustable motor bases and idlers are frequently eliminated. With no "extras" and practically no maintenance, here is true economy.



BELTS

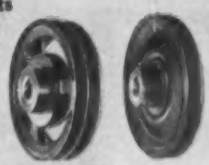
PULLEYS

get more **drive** *with Maurey drives*

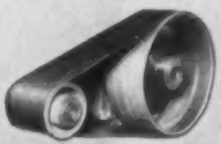
Positive Drive Belts

Variable Speed Belts

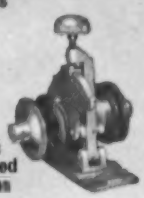
Mor-Grip V-Belts



Hi-Q FHP V-Pulleys



Complete heavy duty V-Belt Drives



Maureymatic Variable Speed Transmissions

Sprockets

Roller Chains

WRITE FOR CATALOGS

maurey

MANUFACTURING CORPORATION

2907-23 So. Wabash Ave., Chicago 16, Ill.

Phone: Dansbe 6-5151

Fast Service from these Maurey Warehouses

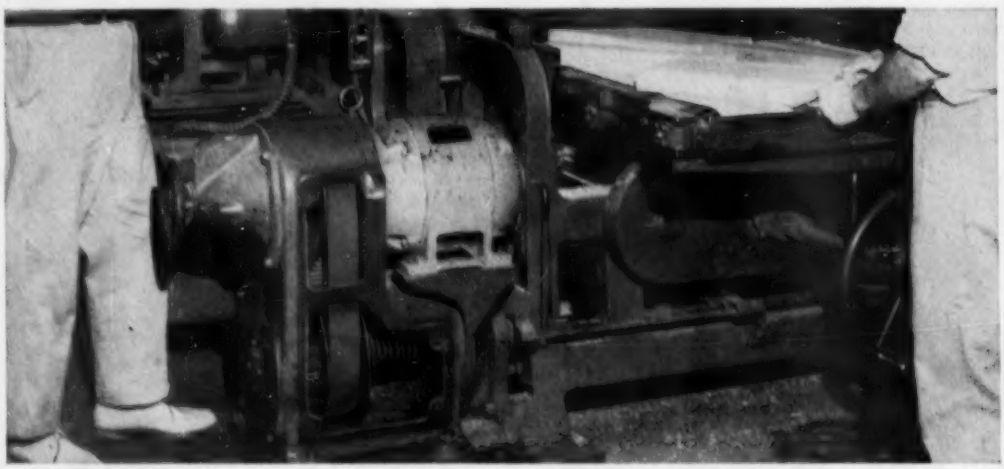
CLEVELAND: 3200 Lakeside Avenue • Phone: MAin 1-2242

KANSAS CITY, Mo.: 1728 Walnut • Phone: BAltimore 1-3330

See your Maurey Distributor for help in selecting the right positive drive for your requirements. Write for catalog information.

Circle **28** on Reader Service Card

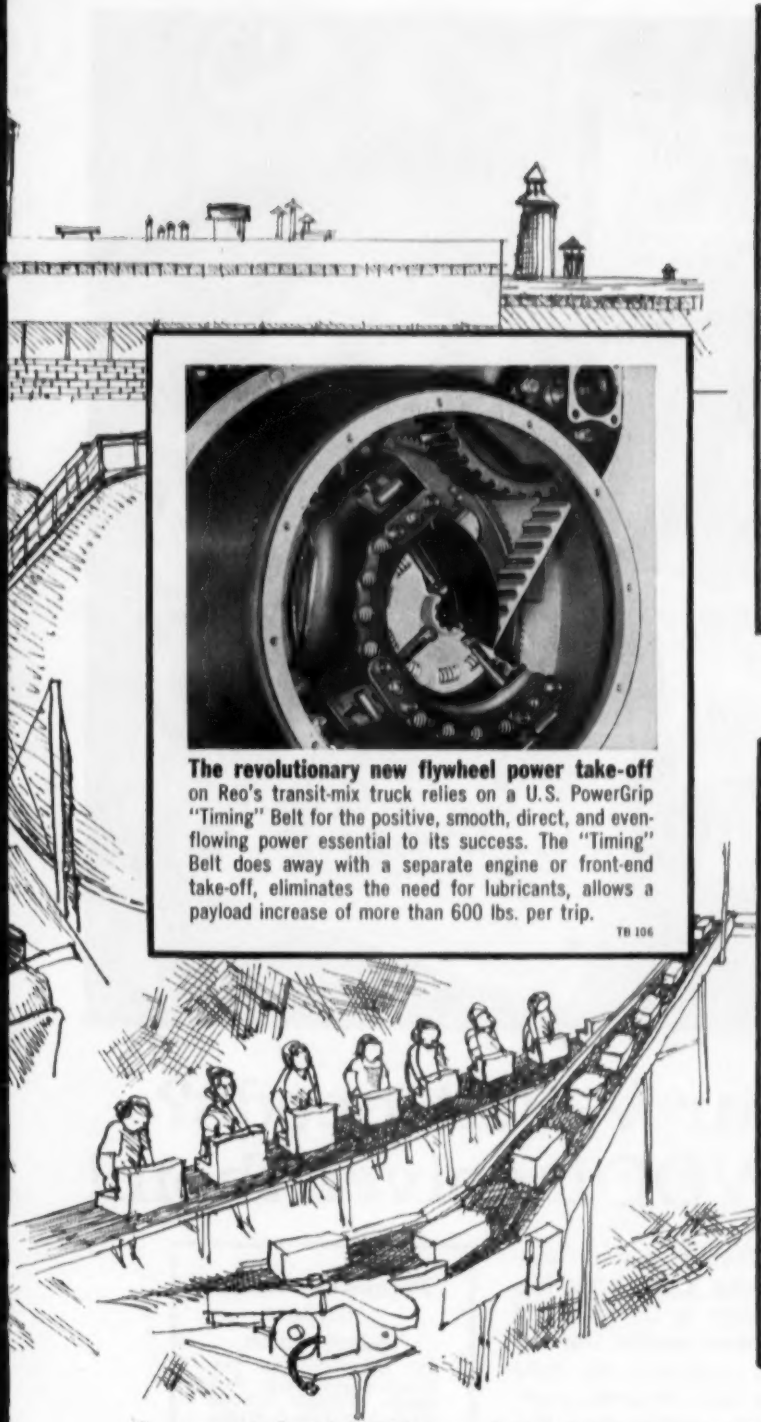
AT THE HEART OF INDUSTRY...



Making things hum for the world's largest piano manufacturer, this U.S. Royal Variable Speed Belt drives a Whitney double planer 2 shifts a day, 5 days a week at Wurlitzer's De Kalb, Illinois, plant. Installed after a competitive belt failed, this belt requires no maintenance, will last far longer, is non-squashing, non-sagging, completely reliable at speeds of 10 to 2,000 rpm.

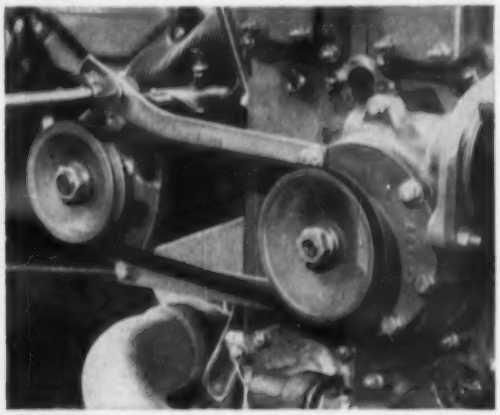
VSB 102

Facilitating the transmission of power has long been a major contribution of U.S. Rubber...through industrial rubber products that simplify the design, improve the efficiency, and maximize the reliability of all power equipment. US has, and supplies, the products which make better power equipment possible.



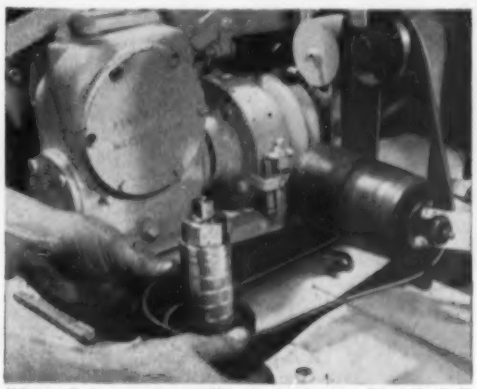
The revolutionary new flywheel power take-off on Reo's transit-mix truck relies on a U.S. PowerGrip "Timing" Belt for the positive, smooth, direct, and even-flowing power essential to its success. The "Timing" Belt does away with a separate engine or front-end take-off, eliminates the need for lubricants, allows a payload increase of more than 600 lbs. per trip.

TB 106



Many thousands of test hours on aircraft engines have demonstrated the remarkable efficiency and stamina of U.S. Rubber V-Belts to Continental Motors. Used to drive the generator on aircraft engines at 4,600 rpms, these belts have excellent length stability, require no maintenance, eliminate many metal parts, and render outstanding service in torque transmission.

VB 158



"One of the most grueling tests for a rubber belt," describes the job of US Flat Belts for Devere Rotary Power Mowers. These belts transmit power from the horizontal motor shaft to the vertical cutter shaft; perform at 3000 rpm while twisting through a 90° angle; must resist dust, dirt, oil, and gasoline. In addition, a U.S. Royal V-Belt propels the power mower.

FB 101

For every industrial rubber product need, turn to US. For Conveyor Belts, V-Belts, the original PowerGrip "Timing"® Belt, Flexible Couplings, Mountings, Fenders, Hose and Packings . . . custom-designed rubber products of every description. Discover why U.S. Rubber has become the largest developer and producer of industrial rubber products in the world. See your U.S. Rubber Distributor or contact US directly at Rockefeller Center, New York 20, N. Y.

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber

MECHANICAL GOODS DIVISION

Circle **46** on Reader Service Card

What are your V-Belt needs? DURKEE-ATWOOD solves them!

When you buy V-Belts, you want full-rated power transmission, consistent performance and long, trouble-free life. Power drive problems vary from industry to industry and machine to machine, whether OEM or replacement. Durkee-Atwood can meet any of your V-Belt needs with the right belt, a belt made with the newest high tenacity fibres, carefully engineered and thoroughly tested for performance. For any of your V-Belt needs, or for drive design assistance, contact your nearest Durkee-Atwood distributor or factory representative. Or write direct to Industrial Division, Durkee-Atwood Company, Minneapolis 13, Minn.

Industry's most complete V-Belt Line

DA 358 V-Belts • DA Positive Drive Belts • Red Shield Multiple V-Belts Variable Speed Belts Steel Cable V-Belts Double V-Belts • FHP V-Belts • Open End V-Belting • Railroad Belting Sturdy-Link Belting.

Look for the DA *On Your V-Belts*

DURKEE-ATWOOD V-BELTS

DURKEE-ATWOOD COMPANY MINNEAPOLIS 13, MINNESOTA

Circle **14** on Reader Service Card

POWER TRANSMISSION DESIGN®

THE MAGAZINE OF MACHINE DRIVES

NOVEMBER 1961

volume 3 number 11

FEATURES

HOW TO DESIGN SHAFTS FOR MACHINE DRIVES 19

Includes nomograms for finding the minimum diameter for keyed shafts. Also shows how to calculate stress concentration factor in a rounds shaft.

TORSIONAL VIBRATION PART 3—GEARING 25

Analyses effects of vibratory load on bearings, and vibratory torque on teeth.

MAINTAIN YOUR ELECTRICAL CONTROLS 27

Tear-out guide for posting on control boxes will give you the basis of a thorough maintenance program.

CONTINUOUS CHAINS DRIVE AUTOMATIC MACHINE 32

Machine loads, fills, plugs, seals and tests more than 250 fountain pen cartridges per minute.

PULLER DRIVE IMPROVES EXTRUSIONS 34

A two-stage reducer powers an automatic puller drive for clamping off extrusions.

NEW WAYS TO MEASURE FRICTION 36

New techniques for measuring surface roughness use interferometers, electrolytic capacitors and radiation counters.

BEARING SECTION

BEARING LOCATION CAN COST LESS 40

By Hudson T. Morton

Knowing the right mounting procedures and accessories can save you money and still get the most from your bearings.

FREE MAINTENANCE SCHOOL FOR BEARING USERS 44

Course for supervisors on bearing manufacture, types, numbering systems and preventive maintenance.

PAUL ROLNICK
publishing director

J. J. BUNTING
associate editor

JOHN HOSTAK
associate editor

HAROLD BELANGER
bearings editor

KENNETH MARSHALL
assistant editor

BERT BENKENDORF
art editor

HENRY LEFER
eastern editor

SCHOLER BANGS
western editor

DR. DAVID KINSLER
distilled writing

ALARIC MAUSSER
art director

CAROL GERBASI
editorial assistant

FACTS AT YOUR FINGERTIPS:

Before going farther, tear out a Reader Service Card which you will find bound into this issue. Fill it out as you read and mail it when you're done. We'll act on your request immediately.

DEPARTMENTS

NEWS 8

MEETINGS 12

POWER TRANSMISSION AT WORK 14

BEARING BUSINESS 39

***PRODUCT NEWS** 46

***FREE REFERENCE MATERIALS** 50

BOOKSHELF 53

***LITERATURE** 54

MEN 56

ADVERTISERS INDEX 58

copyright 1961 *by The Industrial Publishing Corporation*

and again... **another NEW product from Stearns**

...pace-setting pioneer in electro-magnetic clutches—brakes—clutch-brakes

...the 46,000 Series electro-magnetic DISC BRAKES

for Crane, Hoist, and Winch Applications

A.C. Operation ... Compact, Motor-flange Mounting ... Cast, Dust-tight, Waterproof Enclosures ... 3 Sizes - 500, 750, and 1,000 lb-ft Torque

- UP TO 88% LESS INERTIA (WK^2)...
- UP TO 35% LESS WEIGHT...
- UP TO 40% LOWER INSTALLED COST... than cumbersome, hard to enclose "Flywheel-type" brakes of similar torque and thermal capacity!

• Stearns exclusive unitized construction for faster, simpler installation and maintenance — longer life!

Request Stearns New Product Preview 2-61-B

Stearns ELECTRIC CORPORATION

120 NORTH BROADWAY • MILWAUKEE 2, WISCONSIN

The Complete Line of Electromagnetic Clutches — Brakes — Clutch-Brakes

SINCE 1917—THE CHOICE OF LEADING MOTOR AND MACHINERY MANUFACTURERS

Circle **36** on Reader Service Card

POWER TRANSMISSION DESIGN

BUSINESS STAFF

PAUL ROLNICK .....publishing director
KENNETH MARSHALL production mgr.
N. G. KISER .....circulation manager
ROBERT GAUVIN ....reader service mgr.

FRANCHISE DEPARTMENT

LEWIS DAVIS .....representative
RICHARD PLANCK .....production

SALES OFFICES

Cleveland 15
812 Huron Rd., SU-1-8420
ROBERT WALSH

New York City 17
Rm. 836, 60 E. 42 St., MU 7-3420
LEE HAAS, vice president

Chicago 11
Rm. 704, 520 N. Michigan, WH 3-1655
CHARLES F. GEYER, vice president
ROBERT B. NELSON
SAM TRACY

Los Angeles 57
Granada Building
672 S. Lafayette Park Pl., DU 7-5104
ALAN T. CAZIER, manager

London, S.W. 1
36 Victoria St., SU 6072
JOHN A. LANKESTER, manager

POWER TRANSMISSION DESIGN
is published monthly and copyright 1961 by Power Publishing Company, Inc., a subsidiary of The Industrial Publishing Corporation, 812 Huron Rd., Cleveland 15, Ohio.

LESTER P. AURBACH .....president
EDWIN M. JOSEPH .....executive v. p.
PAUL ROLNICK .....vice president
N. N. GOODMAN, JR. .....vice president
LEE HAAS .....vice president
CHARLES F. GEYER .....vice president
TOM DEMPSEY .....asst. sec./treas.

SUBSCRIPTIONS in U.S. and possessions: $7, 1 year; $12, 2 years. Canada: $8.50 per year. Foreign: $10 per year, payable in advance in U.S. funds. U.K.: £3.5.0 per year payable in Sterling to London office. Out of print copies of Power Transmission Design are available in complete volumes as positive microfilm copies from University Microfilms, 313 N. First St., Ann Arbor, Mich.

AFFILIATED PUBLICATIONS: Hydraulics & Pneumatics, Material Handling Engineering, Handling & Shipping, Modern Office Procedures, Occupational Hazards, Precision Metal Molding, The Refrigeration & Airconditioning Business, Welding Design & Fabrication.

Controlled circulation postage paid at Pontiac, Illinois. Return form 3579 to 812 Huron Rd., Cleveland 15, Ohio.

FC FRANCHISE CIRCULATION — DISTILLED WATER — BPA

in design or modernization of small-horsepower machines...

Fawick small clutch applications increase profit and production

. . . through low unit cost

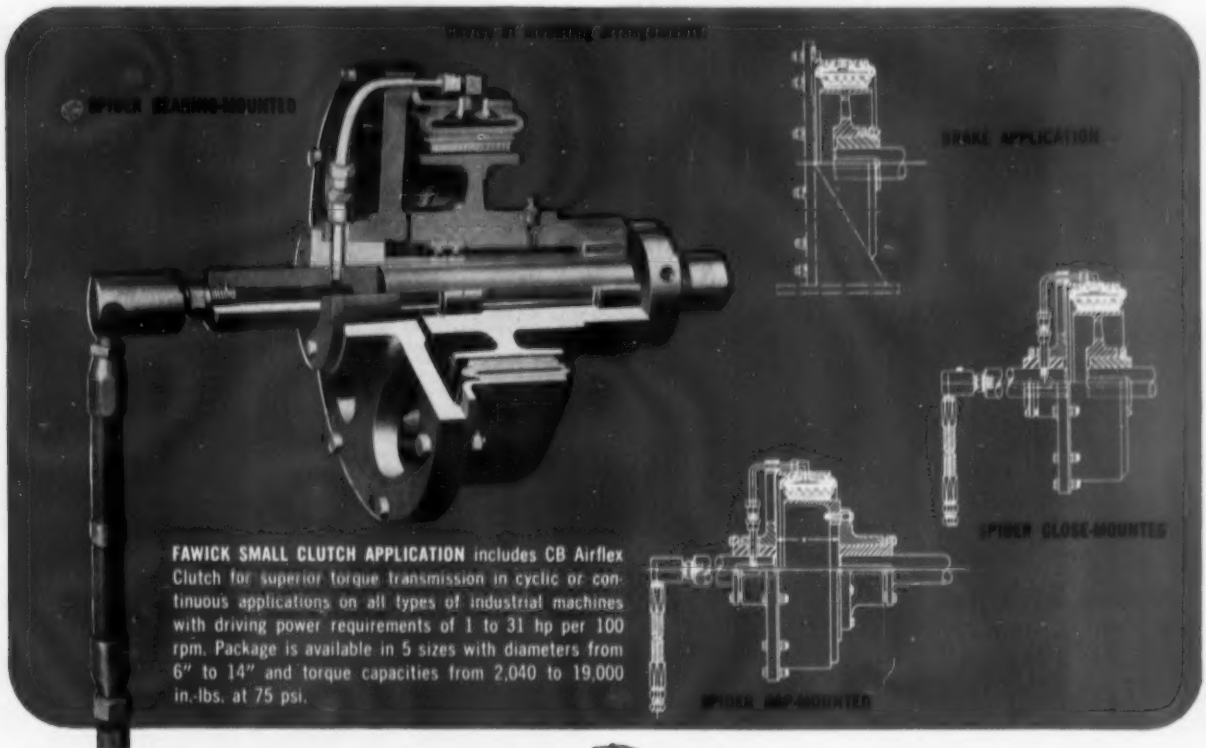
FAWICK Small Clutch Applications are standardized air clutch packages, produced in volume, and priced low for economical design or modernization of cyclic machines with small horsepower requirements.

. . . low installation cost

Complete FAWICK adaptability, with standardized bores and mountings, assures simplified installation in through-shaft, clutch-coupling and brake applications.

. . . and improved machine performance

FAWICK Small Clutches incorporate all the operating advantages of Fawick drum-type air clutches—instant engagement, overload protection, adaptability to local or remote control, automatic self-adjustment for wear and low maintenance. These permit faster machine cycling, greater precision, higher productivity.



FAWICK SMALL CLUTCH APPLICATION includes CB Airflex Clutch for superior torque transmission in cyclic or continuous applications on all types of industrial machines with driving power requirements of 1 to 31 hp per 100 rpm. Package is available in 5 sizes with diameters from 6" to 14" and torque capacities from 2,040 to 19,000 in.-lbs. at 75 psi.

For complete information on the advantages of power transmission by Fawick, call your nearest Fawick representative or write the Home Office.

FAWICK AIRFLEX DIVISION
FAWICK CORPORATION
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

FAWICK AIRFLEX
INDUSTRIAL CLUTCHES AND BRAKES

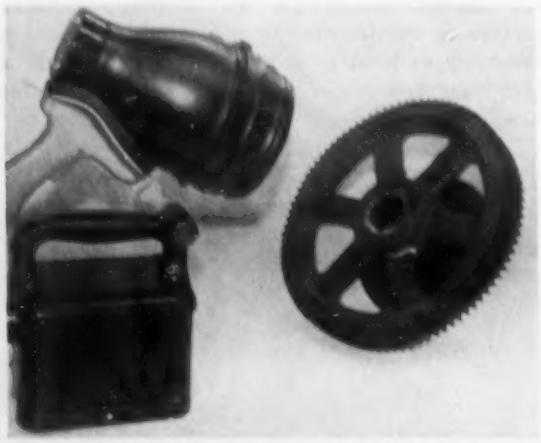
Circle **15** on Reader Service Card

NEWS

FROM THE POWER TRANSMISSION FIELD

New method to detect surface cracks and flaws

A new fluorescent-detector method can find minute hair-line cracks in plastics as well as ferrous and non-ferrous metals. It uses a black-light unit to fluoresce sensitive materials. Defects show as bright-glowing lines or spots.



GLOWING LINE shows crack across the spokes of a gear.

The sensitive material is brushed on the component and penetrates the flaw by capillary attraction. The material is soluble, so the surplus is easily removed with a water rinse.

The method, developed by the United States Casting Repair Corp., is called the Seal-Lock system. It's claimed to cut inspection time by up to 80 per cent.

Selling inventions by computer

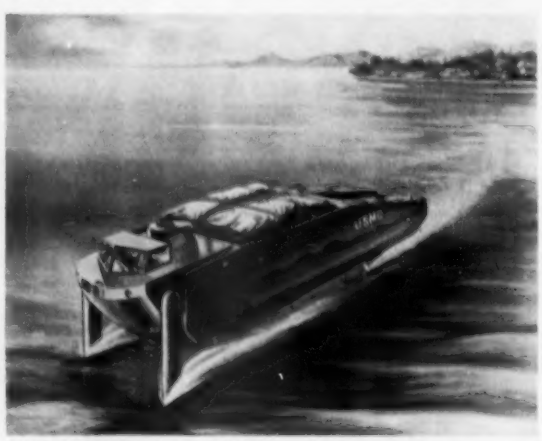
A computer that finds prospective buyers for patented new inventions is one of the services offered by the Institute for New Products (Ardsley-on-the-Hudson, N. Y.) The Institute, originally a publishing service for new developments, now uses a computer to match inventor and prospect. The inventor's patent is analyzed and its characteristics profiled, with potentially as many as 40,000 variable factors. Requests from firms looking for new products or processes are similiarly coded. The two are matched. At this point the Institute modestly withdraws, and negotiations are thereafter carried on privately between inventor and prospect, without commissions or fees.

Bearings distributor wins award at Southeast Show

At the recent Southeastern Plant Engineering and Maintenance Show, the plaque award for the best booth went to the White Bearings Co. of Charlotte, N. C. In making the award, the judging committee said that the company had made the most effective use of mobile displays and plastic cutaways of reducers.

. . . to shores of Tripoli— by hydroplane

The Marine Corps in battle may soon be supplied by amphibious hydrofoil landing craft powered by gas turbines. Under a Navy contract, Avco Corp's Lycoming Div. will develop such a craft, capable of carrying several thousand pounds of cargo through rough seas at up to 45 knots.



HYDROFOILS retract on landing, wheels come down.

To be called the LVH, the hydrofoil will "fly" through rough water, boat through the surf and climb difficult beaches and dunes. Prototypes show overland speeds of more than 25 mph. The marine gas-

Circle 8 on Reader Service Card →

wherever you are, there's a

Cullman Distributor!

Cullman Distributors are located from coast to coast and border to border; therefore you are assured of always getting fast service on Cullman power transmission products. When you want Sprockets, Roller Chains, Flexible Couplings – call on Cullman for prompt delivery.

FACTORY WAREHOUSES AT

821 South Santa Fe Avenue, Los Angeles 21, California
2618 Carnegie Avenue, Cleveland 15, Ohio
205 North 11th Street, Tampa 2, Florida

Cullman Roller Chain Drives

WRITE TODAY for free Cullman literature and other information.

cullman wheel COMPANY

1344 Altgeld Street • Chicago 14, Illinois • BUckingham 1-2800

Roller Chain Drives Since 1893

Excessive heat build-up caused by constant flexing — even in environmental temperatures — is the major cause of V-belt deterioration. BOSTRON with Neoprene remedies this problem.

Neoprene withstands heat up to 165°F. (ordinary belts deteriorate at as low as 115°F.), and gives greater resistance to oils, ozone, chemicals, abrasion. This means a high safety margin, long life.

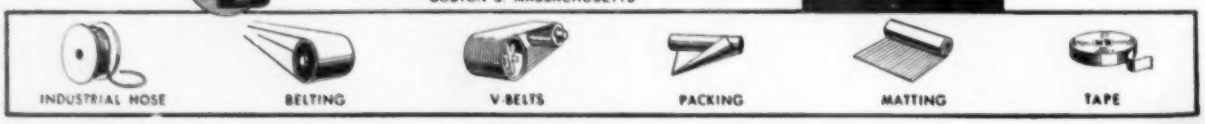
Neoprene with Fiber-Dispersed Stock in BOSTRON'S compression member provides: (1) high cross-wise rigidity, (2) exceptional length-wise flexibility, and (3) extra tensile member support. Fibers are closely packed, in straight lines, and virtually frictionless.

BOSTRON'S Tensile Member, by actual test, gives greater stability, 40% more strength, and is inherently stretch resistant. Moisture gain is only 1/20th that of conventional reinforcing fiber. A special heat and tensioning process for the cords further minimizes stretch. BOSTRON withstands more shock loading, needs less maintenance, and shows minimum growth even after months of operation.

Inside and out, your best buy is **BOSTRON V-BELTS** *with* **NEOPRENE**

AMERICAN BILTRITE RUBBER COMPANY
BOSTON WOVEN HOSE & RUBBER DIVISION
BOSTON 3, MASSACHUSETTS

BOSTON



Circle **5** on Reader Service Card

turbine engine (Lycoming TF-1430) works on a variety of fuels.

The LVH has several unusual features. The hydrofoils, one forward and one aft, are of high-aspect ratio and are completely submerged in the water. On land, they retract entirely within the hull.

There are separate propellors for boating and planing. The planing propellor is mounted on the forward portion of the bottom of the rear strut. The entire lower section of the strut, including the foil and propellor is rotatable for steering. The boating propellor is separately mounted on a retractable drive under the hull.

Wheels are also retractable, with power steering of the front. The 18:00 x 25:00 tires use the Schrader system which controls inflation or deflation from the cab while underway.

Terms of the contract call for delivery of the first of the new craft in January 1963.

Are technical writers keeping up with advances?

Technical writing has not kept pace with technical advancement according to Fred C. Gladeck, president of The M & T contract engineering company in Philadelphia. In announcing a new company division called "Engineering Publications, M & T," he said there was a yawning gap in communications that must be filled if business and education are to benefit from the work of engineers, and scientists.

Robert Herzog, manager of the new division gave an ideal profile of today's technical writer. Qualities needed, said Herzog, include fluency in the engineer's language and ability to put his thinking accurately and effectively on paper.

The days of the free-lance writer, who farmed out the parts he couldn't do, are pretty much gone. The technical writer, thinks Herzog, should be one of today's most high-skilled specialists.

Business news in brief

. . . **Fort Worth Steel & Machinery Co.** will complete construction of an additional 30,000 sq ft to their plant in November. President J. I. Jackson said the expansion will increase the plants' metal fabricating capacity and reduce the handling of materials in process.

. . . **Worthington Corp** appointed five new distributors of power transmission products: **Iskenderian Racing Gams,** Inglewood, Calif; **Temperature Equipment Co.,** Glendale, Calif; **B. C. Pump and Engineering, Inc.,** Merritt Island, Fla.; **Basin Engine and Equipment,** Farmington, New Mexico; and **Southwell Supply Co.,** Pampa, Texas.

INTERNALS made with famous G.S. precision give you better production

It's costly—in terms of machine time, man hours, overhead and customer dissatisfaction—to compromise on quality in Small Gearing for critical applications. You have no such worries when you order your Small Gears from G.S.—specialized equipment, specialized techniques and specialized, long-time experience assure properly designed, accurately cut Gears, produced to an unmatched standard of uniform accuracy. That means *your* production isn't slowed by rejects or imperfections—*your* product will operate smoothly and efficiently in the hands of your customers.

G.S. Internals like those illustrated above, for example, are cut to exacting specifications for such applications as air operated hoists, floor machines, radio equipment, navigating instruments and many other uses. If you use Internals—or any other type of Small Gearing—get G.S. in your picture!

SEND FOR FREE
Small Gearing Guide. Contains useful charts. Send for your copy today!

FRACTIONAL HORSEPOWER GEARING

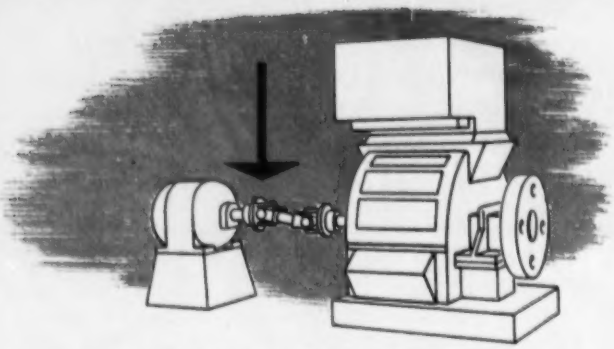
GEAR
Specialties, Inc.
2635 WEST MEDILL AVENUE
CHICAGO 47, ILLINOIS

SPURS • SPIRALS • HELICALS • BEVELS • INTERNALS
WORM GEARING • RACKS • THREAD GRINDING

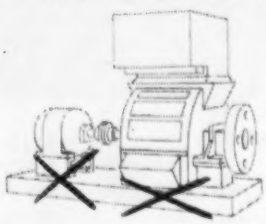
WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARING

Circle **19** on Reader Service Card

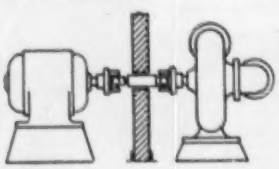
How to make "MISALIGNMENT" profitable with WATSON Drive Shafts



A WATSON drive shaft working at any angle from 1 to 8 degrees transmits power as efficiently as a flexible coupling, yet offers substantial savings in design engineering time and installation cost. Angles up to 20 degrees can be handled (depending on RPM). No painstaking axial alignment is required; simple, low-cost concrete foundations poured on the site replace costly unit base plates.

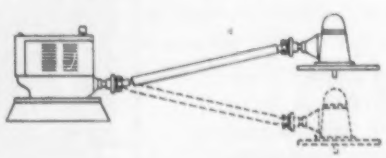


In addition, the use of Watson drive shafts offers:



WIDEST LATITUDE IN LOCATION
of driving and driven elements for best utilization of space, distribution of weight, isolation of motor or engine, provision for maintenance or working space.

PROVISION FOR RELATIVE MOVEMENT
between driving and driven elements, either intentional or as a result of structural deflection or foundation shifts.



WATSON drive shafts are promptly available in 9 sizes, 10 to 800 h.p., for speeds to 4,000 r.p.m. and more. Why not get the facts—now? New 8-page Engineering Data Bulletin F-15a is yours for the asking; please address Dept. 150

WATSON

H. S. WATSON COMPANY
1316 - 67th Street • Emeryville 8, California
1606 Laskey Road • Toledo 12, Ohio

25

Circle **40** on Reader Service Card

MEETINGS

Oct. 29-

Nov. 1 **National Lubricating Grease Institute**—29th Annual Meeting, Rice Hotel, Houston Texas

NOV.

7-10 **Packaging Machinery Manufacturers Institute Show of 1961**—Cobo Hall, Detroit.

9-10 **Society of Automotive Engineers,** Fuels and Lubricants Meeting, Shamrock Hilton Hotel, Houston, Texas.

13-16 **Seventh Annual International Conference on Magnetism and Magnetic Materials,** Westward-Ho Hotel, Phoenix.

13-18 **International Factory Equipment Exhibition,** London, England.

13-18 **Engineering Materials and Design Exhibition,** London, England.

15-17 **Aerospace Electrical Society,** Annual Display, Pan-Pacific Auditorium, Los Angeles.

16 **(1-day) National Electrical Manufacturers Association,** 35th Annual Meeting, Plaza Hotel, New York

26-Dec. 1 **American Society of Mechanical Engineers,** Winter Annual Meeting, Statler Hilton, New York.

DEC.

12-14 **American Society of Agricultural Engineers,** Winter Meeting and Agricultural Engineering Exposition, Palmer House, Chicago.

Mr. Design Engineer

DIAMOND CHAIN CO., INC. makes available to you over 70 years of practical experience and know-how in the manufacture of power transmission products.

Products Manufactured: New No. 760 Catalog describes and illustrates finished steel ROLLER CHAIN, SPROCKETS, and FLEXIBLE SHAFT, "HI CAP" COUPLINGS. Write today for your copy!

Identification: Products are packaged either in clearly labeled cartons or transparent poly bags.

Availability: All products are readily available either from stocks in Indianapolis or from Distributors located throughout the U.S. who give emergency service on short notice.

Engineering Service: Technical engineering service is available on your request from the Indianapolis plant or the DIAMOND district office nearest to you.

Sales Terms: Standard business terms well established through use in American industry.

DIAMOND CHAIN COMPANY, INCORPORATED

A Subsidiary of American Steel Foundries

Dept. 718 • 402 Kentucky Avenue, Indianapolis 4, Indiana

OFFICES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

DIAMOND ROLLER CHAINS ®

Circle **13** on Reader Service Card

Don't let these Devils INTERFERE with OPERATING PERFORMANCE

WEAR
IMPACT
CROSS-PULL
DOWNTIME
BACKLASH

Troublesome maintenance and lubricating problems are eliminated when you specify Thomas "All-Metal" Flexible Couplings to protect your equipment and extend the life of your machines.

Like a thief in the night an inadequate coupling causes wear and damage to your machines — resulting in high maintenance costs and costly shut-downs.

NO MAINTENANCE
NO LUBRICATION
NO WEARING PARTS
NO BACKLASH

UNDER LOAD and MISALIGNMENT only THOMAS FLEXIBLE COUPLINGS offer all these advantages:

- Freedom from Backlash
- Torsional Rigidity
- Free End Float
- Smooth Continuous Drive with Constant Rotational Velocity
- Visual Inspection While in Operation
- Original Balance for Life
- Unaffected by High or Low Temperatures
- No Lubrication
- No Wearing Parts
- No Maintenance

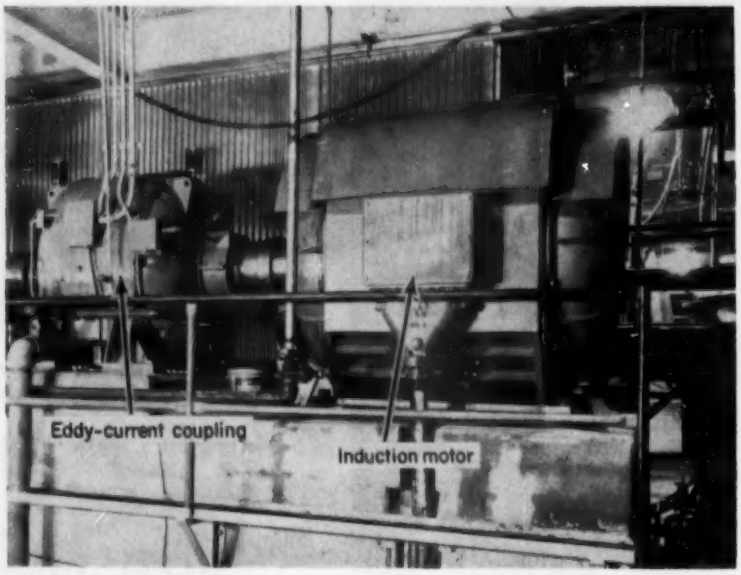
Write for our New Engineering Catalog 60

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

Circle **37** on Reader Service Card

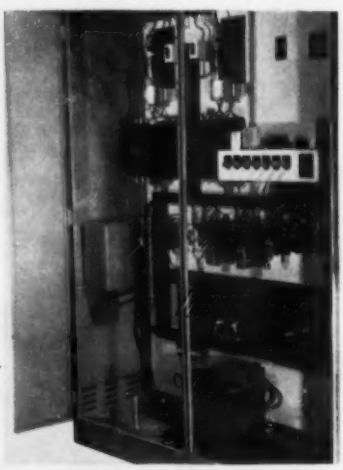
AT WORK

Eddy-current drive needs little maintenance



A 1500-HP INDUCTION MOTOR drives the eddy-current coupling. A gear reducer reduces the coupling output speed to the lineshaft.

Engineers specified an eddy-current coupling to vary the speed of a 1500-hp lineshaft installation for a paper machine. The coupling adjusts overall speed while flat belt and cone pulleys adjust speeds between sections of the machine. Engineers selected this system because of its simplicity and ease of maintenance.



ELECTRONIC CONTROL CABINET for 1500-hp drive for paper machine.

The eddy-current drive regulates speed accurately over a wide range, enabling the machine to produce a variety of papers. Paper speeds vary from 200 to 1,500 fpm, depending on paper weight.

The coupling is a magnetic clutch with electronic feedback that controls the speed. The input member couples directly to an electric motor. Magnetism between the output and input members forces rotation.

A small current controls very high torques. The 1500-hp drive seldom requires more than 2 kw total excitation.

Dynamatic Div., Eaton Mfg. Co., makes the coupling.

Drone sub-killer uses sprag clutches

The U. S. Navy's newest and most promising submarine killer is a drone helicopter armed with a homing torpedo. Taking off from specially modified destroyers, guided by remote control, it can deliver its torpedo to the limit of the parent ship's sonar range, and then return to be rearmed for another mission.

The drone, called the DSN-1, was developed and produced by Gyrodyne Co. It's a 20-ft rotor-span coaxial helicopter, powered by a 72 hp Gyrodyne/Porsche reciprocating air cooled engine (later versions will use a Boeing turbine engine). As in all rotary wing aircraft, a free-wheeling device is essential to avert sudden shock to the main transmission drive and rotor. In this case a sprag-type clutch is used which has a maximum over-running speed of 4500 rpm. The helicopter engine has an idling speed of 1500, and an over-running speed

of 4500 rpm for a maximum 15 minutes. The clutch, specially designed and built for this job by the Formsprag Co., transmits power from an inner to an outer race by the wedging action of specially-shaped sprags. Rotation of one race in the drive direction causes them to wedge, thus transmitting full torque from one race to the other. The sprags are kept in light contact with both inner and outer races by expanding coil springs.

A similar type of clutch is installed in the servo generator drive train which provides an external power source for ground checks of the auxiliary equipment.

At Work continues on page 16

Maxitorq

STANDARD

floating disc

single and double clutches or brakes

DESIGN PRINCIPLES OF THE 3 BASIC TYPES

The Maxitorq Clutch is completely assembled on the clutch body and shipped ready to slip onto a shaft. Separator springs . . . an outstanding feature . . . assure the advantages of truly floating discs. Used between each pair of inner discs, they spread them endways with an accordian action so that light can be seen between all discs when the clutch is in neutral. The floating disc feature makes certain that there's no drag . . . no abrasion . . . and consequently no heat when the clutch is in neutral.

A locking plate on the disc end of each clutch (two on the double types) locks all discs against tension developed by the separator springs. Manual adjustment is made by raising the lock spring, then turning the adjusting ring to give the desired shifting pressure.

Note that assembly adjustment and take-apart are all manual . . . no tools required.

Standard Maxitorq Clutches are available in single and double types, wet or dry . . . also in pulley and cut-off coupling types. Capacities to 15 h.p. at 100 r.p.m. Write Dept. DN for bulletin today.

1CJ60

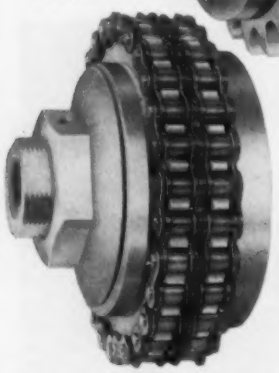
Circle 24 on Reader Service Card

INSURE against COSTLY DOWN-TIME!

DALTON OVERLOAD SAFETY DEVICES

Prevent breakdowns due to jamming

MODEL "OSD" BASIC OVERLOAD SAFETY UNIT



MODEL "OSDC" OVERLOAD SAFETY COUPLING

Dalton Overload Safety Devices are torque-limiting units that prevent costly breakdowns and excessive wear of equipment due to overloading by automatically disengaging when a set maximum load is reached. They are reengaged automatically when the overload is eliminated. The devices are easily adjusted with a torque wrench to a specific maximum torque load.

Write today for OSD CATALOG 961

DALTON
gear company Dept. C
212 Colfax Ave. North, Minneapolis 5, Minn.

DALTON CAN SUPPLY ALL YOUR PRODUCTION GEAR AND SPROCKET NEEDS. SEND FOR QUOTATIONS.

Circle **11** on Reader Service Card

AT WORK

Automatic-stoker drive for boiler

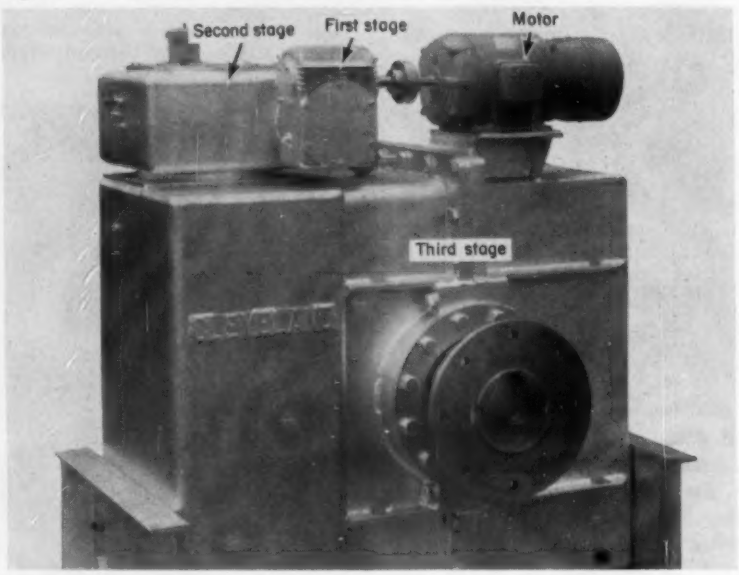
A continuous chain drives a series of screws which feed coal automatically into the combustion chamber of a boiler. The screws operate according to load demand. They provide a seal between the furnace and coal supply.

The coal grate mounts on flexing plates which permit about 1/8-in. flex. This gentle pulsation disturbs the burning coal very little, yet keeps it moving continuously.

Ash is removed by a screw conveyor. The conveyor operates automatically in conjunction with the coal feed. It can be adjusted to suit the ash content of the coal.

Coal boiler made by Canton Stoker Corp., Canton, Ohio.

Speed reducers control dam gates



Eleven 3-stage speed reducers raise and lower the massive gates of a water dam. Total reduction of each reducer is 11,858 to 1.

A 7.5-hp motor drives each of the units through the three stages of worm-gear reduction. The gear shaft of the first stage is threaded and acts as the worm shaft of the second stage. The gear shaft of the second stage is also threaded and extends downward to turn the gear in the final stage.

Gear center distances in each unit are 4, 8, and 21.837 in., respectively. Torque rating of each unit is 1,500,000 in. lb. With an input speed of 1620 rpm, the output shaft makes one revolution every 8½ min.

Housing interiors are coated with oil-resistant paint. A corrosion inhibitor, special oil, and oil-bath filters help to ward off the effects of condensation and freezing.

Made by Cleveland Worm & Gear Div., Eaton Mfg. Co.

If gears rotated the world...

CINCINNATI

CUSTOM GEARS AND GEAR BOXES assure this kind of *dependability*. They are precision made, guaranteed to meet your specifications exactly!

Ask for this brochure—CINCINNATI custom gears are made in all types to 72" diameter cut teeth, 39" shaved teeth, 25" ground teeth.

better still... Send us your prints for quotation

CINTI®

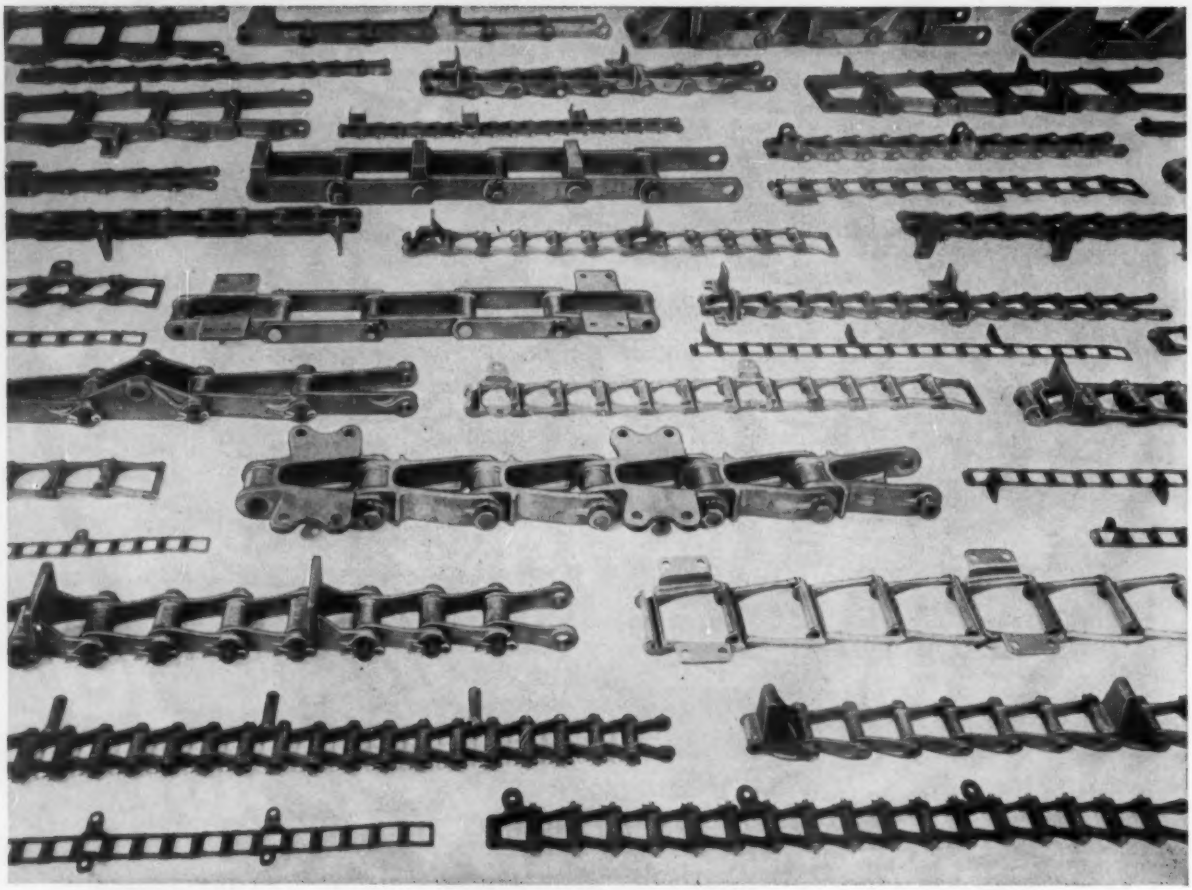
THE CINCINNATI GEAR CO.

Cincinnati 27, Ohio

Custom Gear Makers Since 1907 GEARS, good gears only

Circle **7** on Reader Service Card

Chains change by your choice of attachments! *If you can't find it here...*



Moline can make it for you!

To help you visualize new applications for chains, here are a few of the hundreds of Moline chain and attachment combinations which are available. Each attachment creates a new conveyor device for material handling.

If you do not see just the right chain-attachment combination, Moline has completed a brand new "Designers' Handbook" which shows all types and sizes of chain and attachment combinations, complete with details on application and performance. They'll help you "spark" new ideas for your conveyor or process plant equipment. Write today for your copy.

If standard attachments are not available to meet the needs of your project application, Moline engineers will be glad to work with you on a special attachment. Write or phone for consultation and help on your problem. There's no obligation.

Specializing in the manufacture of chains

Moline authorized distributors are located in all industrial areas and principal cities.

Moline Chains

for conveying, elevating and power transmissions

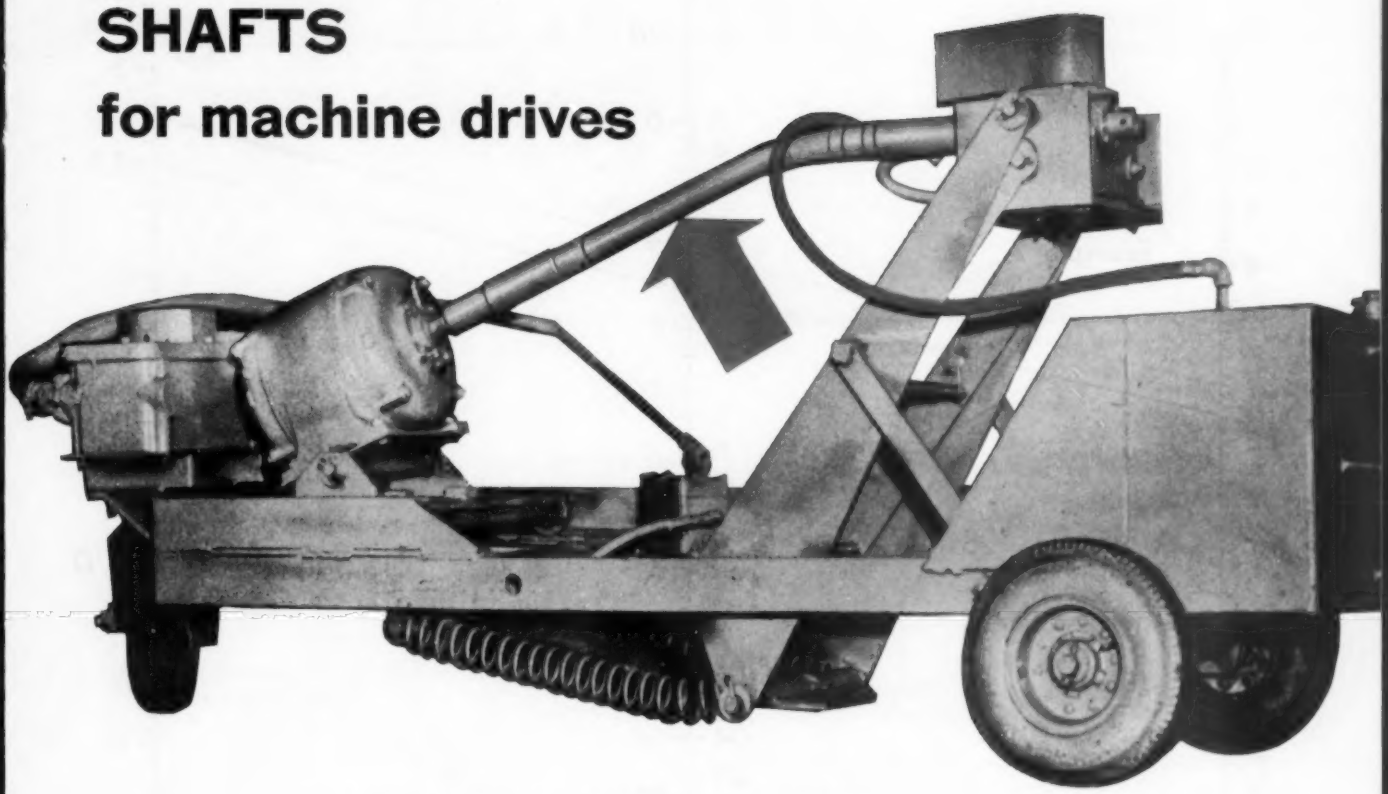
MOLINE MALLEABLE IRON COMPANY

St. Charles, Illinois

Circle **30** on Reader Service Card

POWER TRANSMISSION DESIGN
NOVEMBER 1961

How to design SHAFTS for machine drives



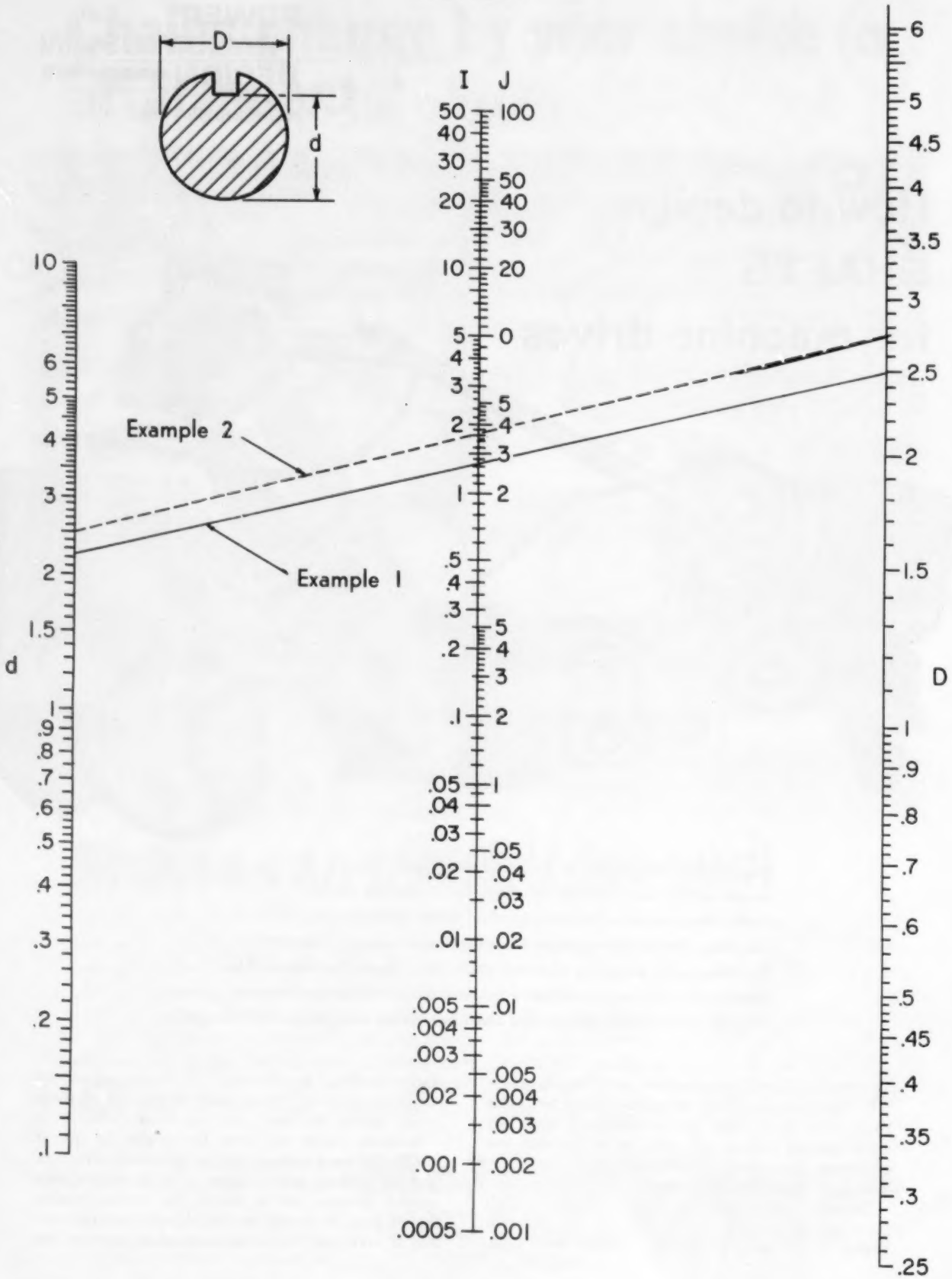
Replacing a driveshaft, or building a new one? This article offers two practical methods for designing shafts. In the first, where a keyway or other stress raiser is defined, use these simple nomograms to select the minimum diameter. In the second, the stress concentration factor must be known. The third part of the article offers a method of determining the stress concentration factor in a round shaft having an abrupt section change.

A SHAFT IS USUALLY DESIGNED FOR ONE STRESS—the greatest service stress that it will feel. This means that most shafts are overdesigned, since the loads imposed on them will often be far less than this maximum. Also, many shafts are arbitrarily sized, for use on multipurpose machinery.

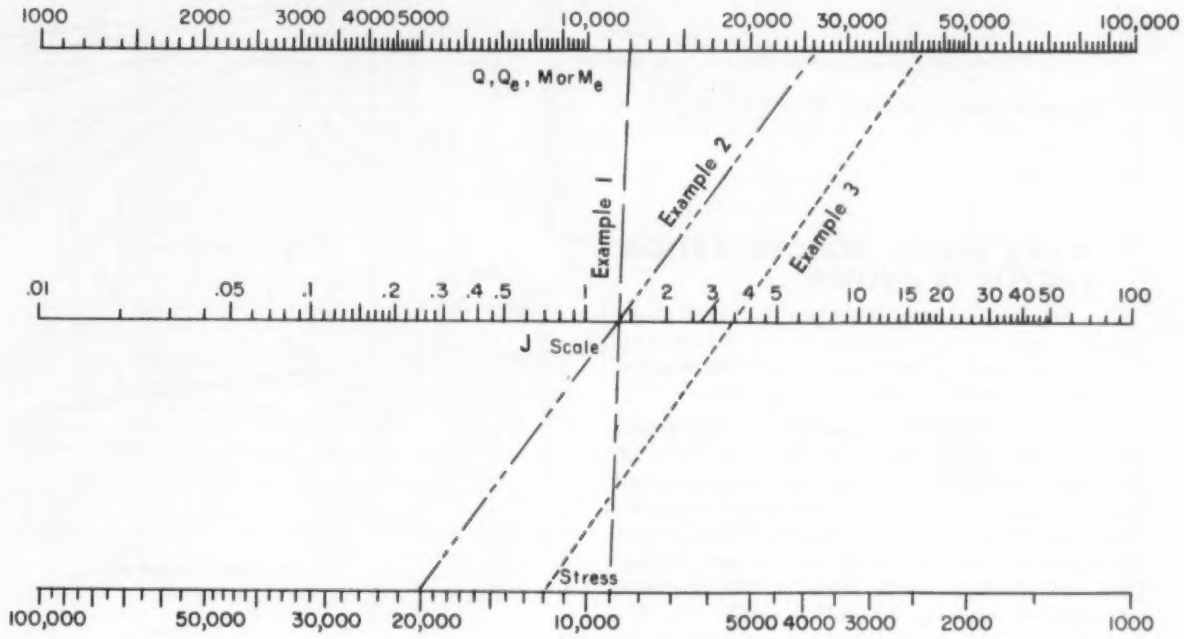
Presently, when engineers have to design a shaft for a special purpose, they rely either on prototype testing, or on background data collected from other, similar shafts in the form of S/N curves and service conditions. (An S/N curve plots the number of stress cycles against the stress peak for those cycles).

However, shafts can often be reduced in size at the design stage without loss of efficiency. The first method outlined below offers a quick approximate method. Results from it should be checked against figures from the second method, if sufficient information is available. The second method is accurate, but

NOMOGRAM 1



NOMOGRAM 2



slower. When the shaft size really counts, pare it to the bone with the second method outlined here.

1 STRESS IN A ROUND SHAFT

The formula for nominal torsional shear stress of a solid round shaft is:

$$f_s = \sqrt[3]{\frac{16T}{\pi D^3}}$$

where:

f_s = Shear stress, psi
T = Torque, lb-in.
D = Outside diameter, in.

The formula for nominal torsional shear stress of a hollow round shaft is:

$$f_s = \frac{16T}{\pi} \cdot \frac{D}{(D)\,4 - (D_1)\,4}$$

where:

f_s = Shear stress, psi
T = Torque, lb-in.
D = Outside diameter, in.
D_1 = Inside diameter, in.

For a keyed shaft

When the shaft section is reduced by the amount of a shaftkey, analysis can proceed in the same way, except that the section modulus must be reduced by an appropriate amount.

New moduli can be computed from the following approximate formulas:

$$J = \frac{\pi D^2 d}{16} \text{ (Torsional section modulus)}$$

and

$$I = \frac{\pi D^2 d}{32} \text{ (Bending section modulus)}$$

where:

D is the original diameter of the shaft and
d is (D — depth of keyway)

Then these revised moduli are used in the standard equations for stress under simple bending or torsion:

$$T = J \times f$$

and

$$M = I \times f$$

where:

T is torque in in. lb
M is maximum bending moment in in. lb
J is torsion modulus of shaft section in in.^{3}
I is bending modulus of shaft in in.^{3} and
f is the appropriate stress (shear stress, or max. tensile or compressive) in psi.

For cases of shafts subjected to combined bending and torsion, both analyses shoudd be made, and the largest resulting value taken for design.

The two nomographs can be used to determine the stresses in keyed shafts, making the following calculation first, where necessary:

—For design on the basis of shear strength, use the equivalent torque, $T' = \sqrt{T^2 + M^2}$

—For design on the basis of tensile strength, use the equivalent bending moment $M' = \sqrt{\frac{T^2+M^2+M}{2}}$

2 WHEN STRESS CONCENTRATION FACTOR IS KNOWN

The first method was developed for steel shafts loaded in pure torsion, but it can be used for bending, or combined bending and torsion. Draw the nominal torsional shear stress cycles to failure curve:

1. Plot S/N curve for completely reversed tensile stresses. (This means where the stress on the shaft goes from a maximum positive to the same maximum negative volume). These curves are usually available, but to draw them use the ultimate tensile strength and the endurance limit for completely reversed loading. Then, the allowable tensile stress at 1000 cycles is approximately equal to the yield strength (Fig. 1). And, the allowable tensile stress at 1,000,000 cycles is approximately equal to the endurance limit of the steel.

2. Plot the S/N curve for completely reversed shear stresses. Shear stress is approximately equal to 0.58 x tensile stresses. Allowable shear stresses for completely reversed loading are obtained as follows:

- Allowable shear stress = 0.58 x tensile stress.
- Allowable shear stress at 1000 cycles = allowable tensile stress at 1000 cycles x 0.58 (Fig. 2).
- Allowable shear stress at 1,000,000 cycles = allowable tensile stress at 1,000,000 cycles x 0.58 (Fig. 2).

3. Should the part be subjected to other than completely reversed shear stresses, such as zero to plus or a plus to plus, a modified Goodman diagram converts the completely reversed shear stresses to the actual (modified) stresses.

Converting from completely reversed allowable shear stress to zero to maximum allowable shear stress for 1000 and 1,000,000 cycles is shown in Fig. 3.

4. The S/N curve (nominal torsional shear stresses v stress cycles) for the desired loading can be plotted (Figs. 4 and 5).

The allowable nominal shear stress curves or S/N curves become approximately straight lines when using log-log coordinates and plotting stress against stress cycles.

5. The S/N diagram is then further modified by reducing the shear stress diagram at 1,000,000 cycles by the stress concentration factor. In effect, this factor changes the slope of the curve.

Fatigue-stress concentration factors are applied by dividing the stress at 1 million cycles by this factor and connecting the point with this value to the stress

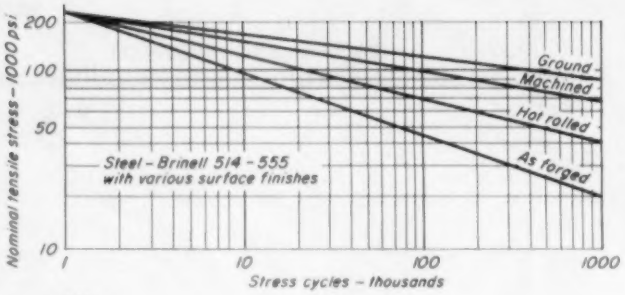


FIG. 1

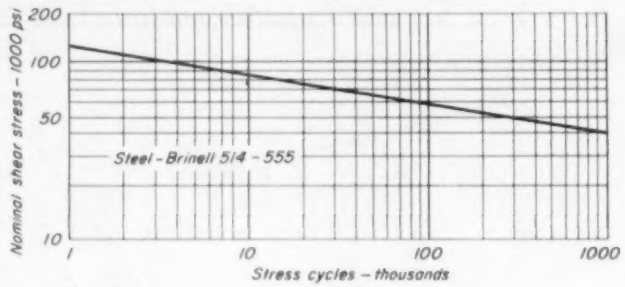


FIG. 2

at 1000 cycles ($K_f = 1.00$) by a straight line. This new curve is the allowable nominal shear stress for the particular section of shaft with a stress raiser. Refer to the S/N diagrams in Figs. 4 and 5.

3 STRESS CONCENTRATION AT A SECTION CHANGE

When a shaft diameter changes smoothly (as in a tapered section), the maximum stress can be approximated accurately from the formula for stress in a round shaft. Use the minimum shaft diameter in the equation for maximum stress. If, however, the diameter changes sharply, a high stress concentration results at the point of section change.

Although these stresses have been calculated theoretically, (F. A. Willers, Z. Math. u. Phys., Vol. 55, p227, 1907) the results are too complicated for practical use. A good approximation is found from the electric analogy method.

Electric analogy to a stressed shaft

For shaft diameters before and after the discontinuity of D and d, and for a fillet radius of r, these curves provide the discontinuity factor k, to be used in the second method. The factor is applied to the equation for twisting, thus:

$$T_{max.} = \frac{k\,16\,Mt}{d^3}$$

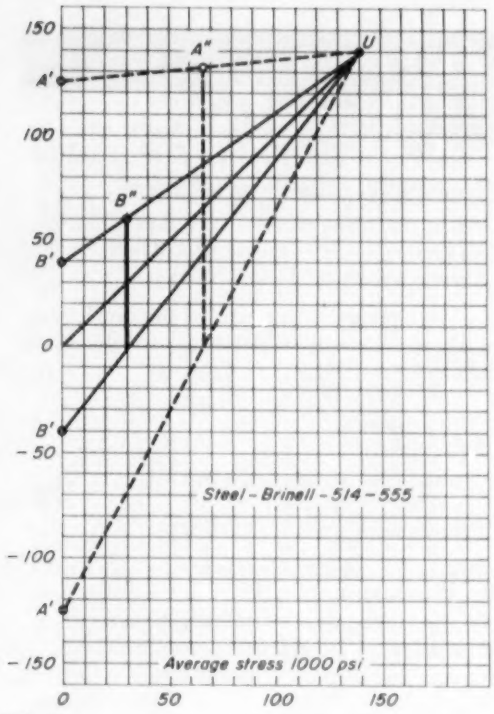


FIG. 3

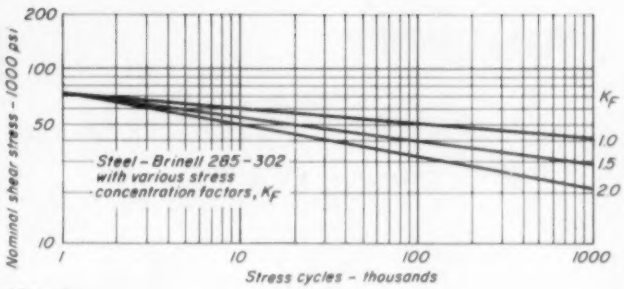


FIG. 4

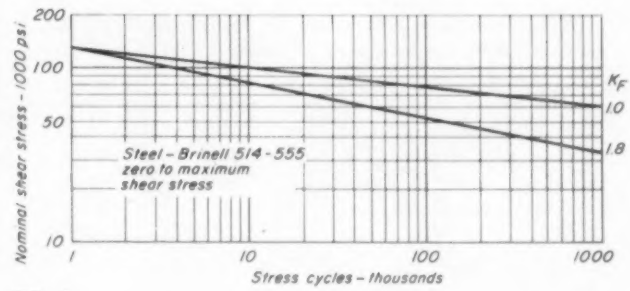
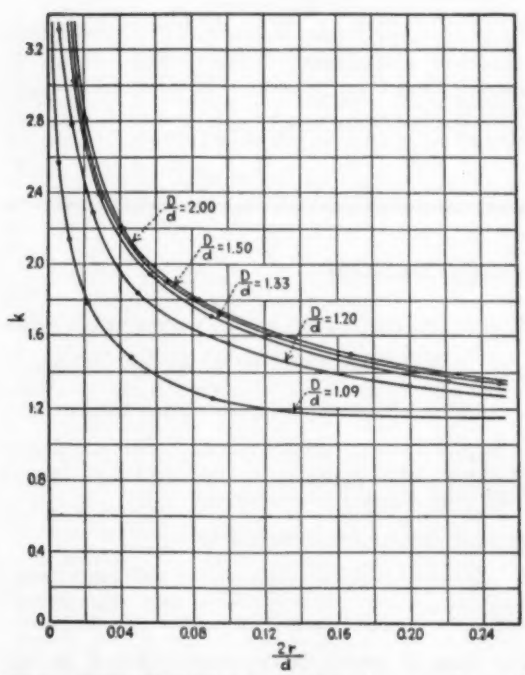


FIG. 5

It can be applied to a shaft subject to bending or shearing, in a similar manner:

$$f_{max.} = f \cdot k$$

where f is the stress at the point under consideration, found from the standard beam formulas.



STRESS CONCENTRATION FACTORS for a collar or diameter change in a round shaft.

EXAMPLE 1

A 2½-in. diameter shaft with a ¼ in. deep keyway in simple bending. Maximum bending load is 12,000 in.-lb.

The section modulus is found from nomogram 1 as before. Reading off the *I* scale:

$$I = 1.35.$$

Use this value in nomogram 2, and the given bending moment. Find the maximum direct stress.

Maximum direct stress $f = 9{,}000$ psi (approx.).

EXAMPLE 2

Given the same loadings, find the proportions for a shaft with a ¼ in. depth of keyway using these permissible working stress values:

Maximum direct stress $f = 20{,}000$ psi
Maximum shear stress $f = 12{,}000$ psi

(a) On the basis of shear strength:

$$\text{Equivalent torque } T' = \sqrt{T^2 + d^2}$$
$$= \sqrt{40{,}000^2 + 12{,}000^2}$$
$$= 41{,}760 \text{ in.-lb}$$

Using this value in nomogram 2 and the maximum permissible value of shear stress,

$$J = 3.5.$$

The nomogram 1 can then be used to establish a suitable diameter to give a torsional modulus of 3.5; e.g., $D = 2.75$ in.

The actual value of d will be slightly higher than that which gives $J = 3.5$. The resulting value of J is 3.6 (dashed line). The nomogram in this instance checks a range of sizes instantaneously, saves many tedious calculations.

(b) On the basis of direct stress,
Equivalent bending moment,

$$M' = \frac{M + \sqrt{T^2 + M^2}}{2}$$
$$= \frac{12{,}000 + 41{,}760}{2}$$
$$= 26{,}880 \text{ in.-lb}$$

Using the nomogram 2 and the maximum permissible value of direct stress,

$$J' = 1.34.$$

In this case, using the nomogram 1, a 2½ in. diameter shaft will meet this requirement.

EXAMPLE 3

Find minimum drive shaft size for an automobile. Stress concentration factors are 1.0 and 2.0 and life is 100,000 miles of operation.

Maximum engine torque = 200 lb-ft
Maximum converter torque = 420 lb-ft
Assume a shaft of 514 to 555 BHN.

Based on assumptions in first part of the article, and nominal stress equations in section 2, the diameters are as follows:

a. 1000 cycles at 420 lb-ft:
D = 0.583 — K_t = 1.00
Nominal shear stress = 130,000 psi
D = 0.583 — for 2.00
Nominal shear stress = 130,000 psi

b. 50,000 cycles at 336 lb-ft:
D = 0.626 for Kf = 1.00
Nominal shear stress = 84,000 psi
D = 0.716 for Kf = 2.00
Nominal shear stress = 56,000 psi

c. 1,000,000 cycles at 200 lb-ft:
D = 0.589 for Kf = 1.00
Nominal shear stress = 60,000 psi
D = 0.742 for Kf = 2.00
Nominal shear stress = 30,000 psi

Bibliography

Design Procedure for Keyed Shafts—*R. H. Warring*, POWER TRANSMISSION (England), September 1959.

Designing Shafts for Finite Life—*P. E. Burke* SAE paper #359 D.

Strength of Materials, Part II—*S. Timoshenko*

TERMS USED IN SHAFT DESIGN

Allowable Stress—Maximum stress which the material can stand without failure for a given number of cycles. Maximum stress which the material can stand for an infinite number of cycles is the endurance limit.

Allowable Nominal Stress—Maximum allowable stress, reduced by the fatigue stress concentration factor. S/N Curve—A plot of allowable nominal stress of a particular section versus the number of stress cycles to failure.

Nominal Stress—Stress calculated by the simple torsional equations.

Torsional Buckling—Hollow, thin-walled shafts may buckle under torsion when the stress exceeds the critical value.

Theoretical (geometric) stress concentration factor:

$$K_t = \frac{\text{maximum stress of the section}}{\text{average stress of the section}}$$

K_t is obtained analytically from the elastic theory, or experimentally by such methods as photo-elasticity and strain measurements.

Fatigue stress concentration factor:

$$K_f = \frac{\text{endurance limit without stress raiser}}{\text{endurance limit with stress raiser}}$$

The fatigue stress concentration factor is considered maximum at 1,000,000 cycles and diminishes to 1.0 at 1000 cycles.

TORSIONAL VIBRATION

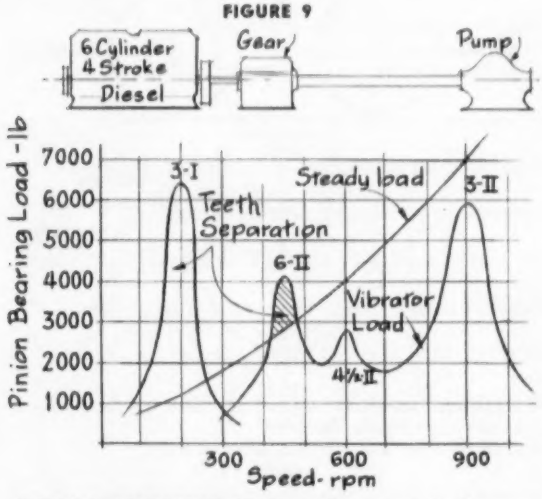
By T. W. SPAETGENS, *Consulting Vibration Engineer, Toronto and Vancouver, Canada*

PART 3 — Gearing

WHEN HIGH ALTERNATING TORQUES are transmitted through gear drives, every part suffers strains which they were probably not designed to withstand. The shaking applied to the gear housing can even fatigue the fastenings and create vibration in the surroundings.

A variable-speed diesel-pump set, and its torsional vibration characteristics are shown in Fig. 9. Normal operating speed is 900 rpm. This unfortunately coincides with the 3rd order 2nd mode torsional vibration critical. The bearing load consists of a 7000 lb steady power transmission component and a torsional vibration load of ± 6000 lb. This vibratory load is reversed each cycle, transmitting a shaking force of 6000 x 20 = ± 120,000 in. lb to the gear housing. The shaking moment causes considerable vibration in the foundation and breaks the hold-down bolts. It also breaks shafts, causes seal failures, and noisy operation.

FIGURE 9



NORMAL OPERATING SPEED of this geared diesel-pump set coincided with a severe torsional vibration critical. Proper consideration of the effects of torsional vibration in the design of the set could have avoided the problems which this coincidence created.

Next month's article on damping techniques will conclude this four-part series. Part I dealt with fundamentals and included a glossary of terms. Part II covered multimass systems. For reprints of complete series, write: Reprints, POWER TRANSMISSION DESIGN, *812 Huron, Cleveland 15, Ohio. Prices; 1-9 copies 75c each; 10-49, 50c ea. over 50, 30c ea.*

Bearing Life

In about five months three radial pinion bearings failed. The lives of the three sets of bearings were 400, 450 and 1500 hr. Calculation of bearing life based on only steady load (7000 lb.) is:

Bearing rated load (radial) . . . 8840 lb for 500 hr. minimum, at 900 rpm.

Minimum (10 percent failure) life . . . 500 x $(8840/7000)^3 = 1007$ hr

Average life . . . 5000 hr.

Maximum (100 percent failure) life . . . over 15,000 hr.

The three bearings failed within 1500 hr, so the actual maximum life (100 percent failure) was far short of that calculated. Torsional vibration reduced bearing life by 90 percent even though only a small number of bearings are involved.

There are different ways to evaluate vibratory load effects on bearing life. One uses an equivalent load which is the root-mean-cube of the total time-load variation. Plot the load variation of 1000 to 13,000 lb, cube it and plot it again. Take the mean (equal area) of this cubed sinusoidal curve and then the cube root of this mean. This is called an equivalent steady load, and works out to be 9490 lb. Now, minimum calculated life is:

$500 \times (8840/9490)^3$ . . . . . 404 hr.

Average life . . . . . 2000 hr.

Maximum life . . . . . over 6000 hr.

This treatment assumes the dynamic effects randomly load the inner race. In this bearing, specific regions of the inner race (three regions, since vibratory loading occurs three times per revolution of inner race) are subject to vibratory loading. Experience shows the life is reduced by a factor of 1.73 for a single point concentration. Thus, maximum life becomes $6000/1.73 = 3500$ hr.

This is over twice the observed maximum life of 1500 hr. Other factors, such as lubrication, cyclic

BROKEN TEETH on spur gear. Vibration makes tooth wear faster. When teeth are badly worn, a mild shock breaks them.

WELDING occurs when the heat of tooth sliding against each other is excessive. This gear is ruined.

speed of inner race due to torsional vibration, and poor statistical sampling, probably account for the remaining disparity. Obviously, the conventional steady load analysis falls far short in predicting bearing life under vibratory conditions.

Teeth Separation

When vibratory torque on the teeth exceeds power torque, teeth separation occurs, the backlash allowing mating teeth to hammer, causing noise. This may cause excessive wear and tooth peening and pitting on both their front and back faces. The shock effect of teeth separation augments the fatigue loading on bearing, shaft, and gears. These effects are more severe when separation occurs at higher mean loads.

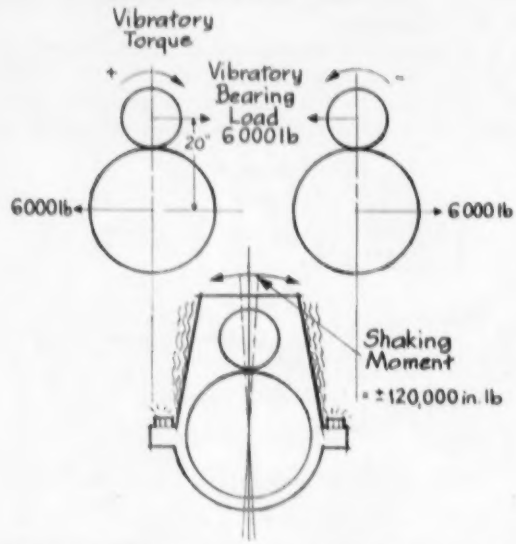
Free branch systems in reverse/reduction gears whose design loads are considerably higher than their actual loads separate under small vibratory effects. They are noise producers, but generally do not come to grief because of separation.

Teeth separation noise is not usually sufficient warning of vibrational damage. Even without separation, the vibratory loading can approach 100 percent of the steady loading, and can inflict serious damage. The effective fatigue safety factor for gear teeth is often less than 2 related to the structural fatigue strength of the tooth as a beam. This is based on a zero-to-rated tooth loading and allows for the usual dynamic, but nonvibratory, factors. If this load is then augmented by vibration so as to go from 0 to, say, 1.90 x rated, structural fatigue or premature wear of the teeth will result.

Automobile Drive

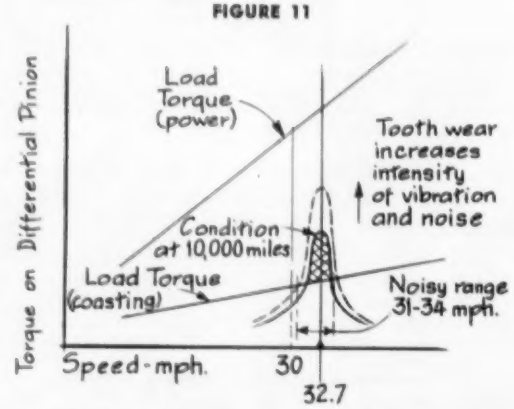
Fig. 11 shows the vibratory and load torques at the differential pinion mesh of a late-model automobile. The critical at 32.7 mph is set up because the differential teeth engage at one of the natural frequencies of the transmission—drive shaft—differential—axles and wheel system. The vibratory torque induced is less than the full power torque. So no teeth separation, and hence no noise, occurs. However, when the car is coasting, the power torque is reduced and the differential whines audibly between 31 and 34 mph. Since the degree of excitation depends on tooth profile accuracy, the whine (a function of vibratory torque less load torque) becomes progressively louder as the tooth profile wears and deteriorates.

FIGURE 10



SHAKING MOMENT on the gear case for the example (above), graphically illustrated.

FIGURE 11



AUTOMOTIVE DIFFERENTIAL, considered in example.

Maintain your electrical controls

By JOHN J. HOSTAK . . .
Associate Editor

Gearmotors, electric clutches, brakes, torque converters—they're no more reliable than their controls. Electric motors supply over 90 percent of all horsepower required by stationary machinery. Each motor has to be connected to a power source. This may be done with a simple switch, or with a more complicated device such as an integrated control. But, all controls have moving parts and need maintenance. A simple defect, not promptly recognized and corrected, can start a chain reaction that results in complete failure. Here is a maintenance guide on which to base a thorough maintenance program.

WHEN AN ELECTRIC CLUTCH FAILS TO ENGAGE at the proper speed, look first at the line voltage. Low voltage is a common source of trouble, especially in smaller systems.

Low voltage can show up in a system during starting or running. If running, the motor draws too high a current. This trips the overload relay frequently. Voltage may even drop to the point where the contactor rides back on the springs and freezes the tripper.

The power-transmission system's motor speed, horsepower, reliability, depend on electrical controls. Examine controls regularly to prevent trouble from developing.

Remove dust, dirt, and grease. Dust can cause short-circuiting. Blow it away if it's dry—use a commercial solvent for sticky dust and grease.

Contactors need the most care. Inspect their bearings for free operation, and don't lubricate them unless the manufacturer says to. Then, use the lubricant he recommends. Remove deposits on contacts with sandpaper or

Continued on page 30

The Guide on the next two pages should be torn out and posted near your control box. Use the "Interval" column to show maintenance intervals —weekly, monthly etc. Use the "Preventive" column for manufacturer specifications—contact pressure, lubricant, etc. The Guide is designed for photostating so that you can make your own copies.

MAINTENANCE GUIDE

MANUALLY OPERATED CONTROLLERS

TROUBLE	PREVENTIVE	INTERVAL	CURE
Contact burning	Measure contact pressure. Should be _____ Aline contacts.		See prevention.
Resistors burn out	Always complete starting sequence.		Replace.
Fails to pick up	Good general maintenance.		Usual cause, low coil voltage; no specific cure.
Fails to hold in	Maintain specific magnet gap. Should be _____		Adjust magnet gap.
	Note coil specifications. Should be _____		Replace burned out or incorrect coil.
Fails to drop out	Clean and adjust pivot.		Voltage not removed, no specific cure.
	Lubricate, if permitted. Use _____		See prevention.

CONTACTS

Short contact life	Measure current. Should be _____		Use special tips or larger contactor for high current.
	Readjust for "bounce" on opening or closing. Pressure _____		
	Inspect and adjust contact pressure. Should be _____		Use new contacts and/or springs if pressure is too low.
	Check for and remove abrasive dust.		Put in dust-tight enclosure.
Contacts chatter or pump	Examine and adjust connections in control circuit.		Make proper connections.
	Check shading coil.		Replace if broken.
	Inspect interlock. Pressure should be _____		Increase wipe and pressure on sealing interlock.
Overheating	Examine for and remove copper oxide.		File lightly.
	Determine load. Should be _____		Reduce load or use larger control.
	Measure contact pressure. Should be _____		Adjust to proper pressure. Replace contact and spring if wear allowance is used up.
Weak pressure	Examine and tighten connections.		See prevention
	Inspect tips for wear.		Replace worn tips.
	Measure voltage. Should be _____		Correct voltage, use lower voltage coil.
Welding of contacts	Measure current and voltage, adjust to proper amount.		Use larger device if current is abnormally high
	Inspect and adjust spring pressure.		Replace springs.

SLIDING CONTACTS

Overheating	Measure current and contact pressure. Dress copper contacts, lubricate properly.		Use special alloy contacts.
Burn too much	Inspect lever operation.		Operate slower.
Irregular surfaces	No maintenance.		Smooth surfaces, do not use emery cloth.
Abrasion	Lubricate properly with petroleum jelly.		

THERMAL OVERLOAD RELAYS

Fails to trip	Note heater specifications. Should be _____		See manufacturers' instructions.
	Clean and adjust.		
	Inspect for short circuit.		Replace relay.
	Check ambient temperatures of motor and relay. Should not exceed _____		Install both in uniform temperature.
Trips at too low current	Note heater specifications. Should be _____		See instructions.
	Check calibration.		Refer to factory.
Trips on starting	Inspect starting cycle of motor.		Refer to factory.
Fails to reset	Check for broken mechanism.		Replace relay or broken part.
Relay contacts burn	Inspect for short circuit.		Repair wiring.
	Clean and adjust.		
	Check vibration.		Remount control.

MAGNETS

Noisy	Clean and lubricate; use _____		Low voltage can cause. Use lower voltage coil, or raise voltage.
	Aline.		Broken shading coil must be replaced.
Fails to open	Clean off grease and dirt.		See prevention.
	Aline.		

COILS

Open circuit	Adjust voltage. Should be _____		Adjust voltage.
	Inspect interlock.		Repair interlock—not making contact.
	Check timing sequence.		Adjust for proper energizing time.
Coil fails	Clean regularly.		Use special coils to overcome corroding.

a fine file. Never use emery paper because it embeds in the contact face and continues to wear.

Springs maintain the contact pressure. If contacts wear too thin, spring pressure decreases. Over-heating results and the spring loses its temper. This decreases the contact pressure further. Measure the spring tension with a scale according to the manufacturer's instructions.

New methods of impregnation have greatly reduced coil burnouts. However, if an ac coil fails, look for mechanical binding or blocking in the contactor.

When writing to the manufacturer about your control equipment, be sure to include the following:

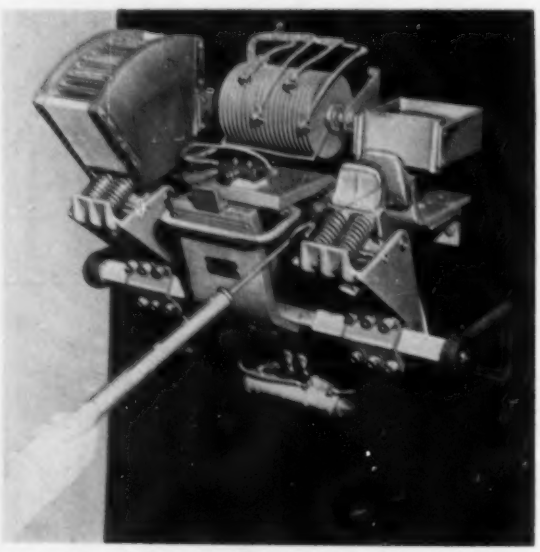
1. Manufacturer's order number, if available.
2. Nameplate data on the controller.
3. Duty cycle and details of operation.
4. Service factor—length of time in service, total number of operations.
5. Voltage, current, and frequency.
6. How the failure occurred.
7. Line voltage at time of failure.
8. Other pertinent information.

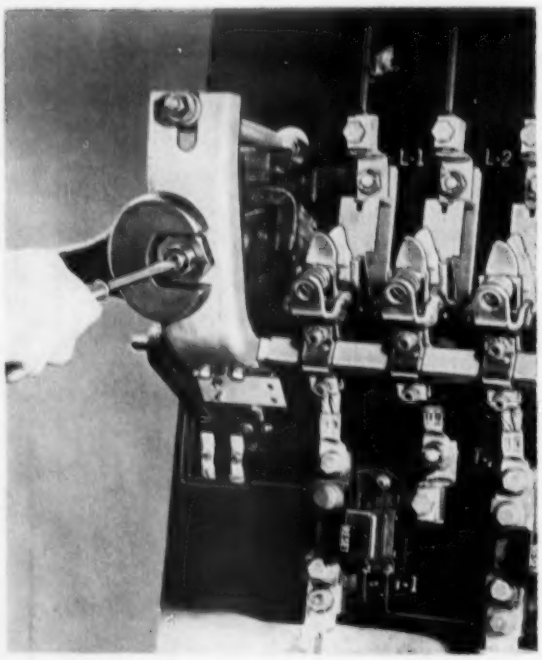
Allow only skilled men to service electrical equipment. A periodic inspection schedule should be set up and followed. Precautionary maintenance saves parts and down time.

This maintenance guide will help you detect and fix most troubles with electrical control devices. ◆

Technical assistance supplied by Allis-Chalmers Manufacturing Co., Milwaukee.

PROPER INSTALLATION and maintenance of controls is vital to performance. It's wise to measure line voltage. Be careful—unskilled workers could wreck your machinery, and kill themselves. Low voltage is especially apt to show up during starting.

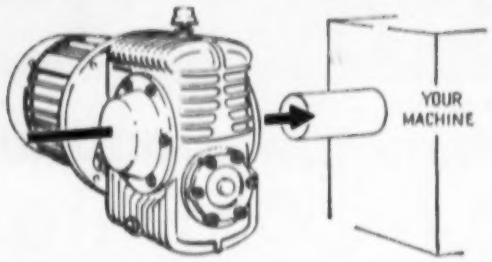




TO INSURE SEALING and alinement of armature with magnet, adjust screw as shown. Be sure armature closes simultaneously on top and bottom of E-frame. Accuracy is important here, because a slight change in the magnet's position can alter the cut-out voltage considerably.

MEASURE SPRING TENSION with a scale according to manufacturer's recommendations. Write the correct tension on the maintenance guide, and hang it near the control box. And a hint for the health-conscious—don't try measuring spring tensions with the power on!

CONE-DRIVE GEARMOTORS for "PLUG-IN" POWER

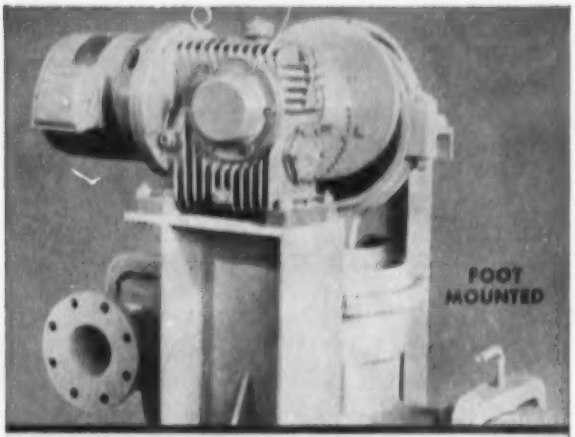


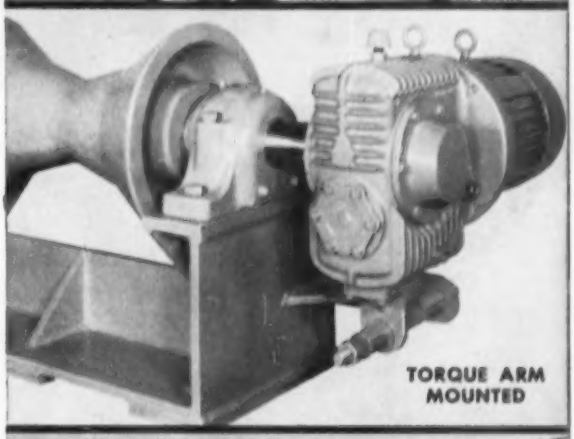
Hollow-Shaft Speed Reducer-Motor forms complete power transmission package . . .

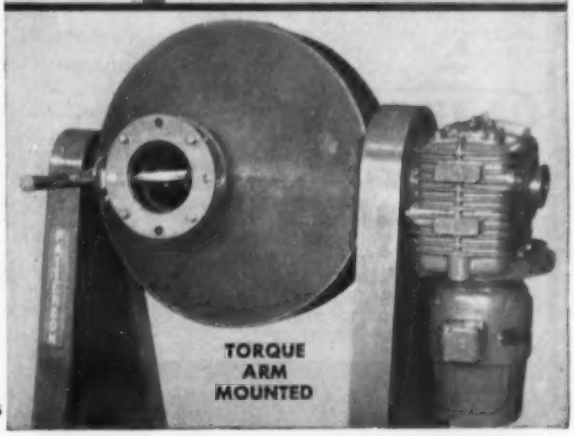
With the compact, right-angle Cone-Drive gearmotor the machine designer can make use of an integral drive package of nearly any required speed and horsepower. Twenty-seven standard output speeds from 7.3 to 525 RPM (with 1750 RPM motor) are available in models from ¼ to 40 horsepower. Gearmotors can be specified with hollow shaft for mounting in any position, ready to "plug-in". You can use this integrated power package to provide a simple, clean installation on your machine . . . no pulleys, belts, sheaves, bed plates, couplings, etc.

Electric motors are standard "D" flange type with slight shaft modification for driving helical primary reduction gears. Secondary reduction stage is a standard Cone-Drive double-enveloping worm gearset with maximum tooth engagement for greater load carrying capacity in smaller space.

Cone-Drive gearmotors are available for all AGMA service ratings. Call your Cone-Drive representative today or write for catalog #58 for complete specifications.







CONE-DRIVE GEARS
DIVISION MICHIGAN TOOL COMPANY
7171 E. McNichols Road Detroit 12, Michigan Telephone: TWinbrook 1-3111

DOUBLE-ENVELOPING WORM GEARSETS

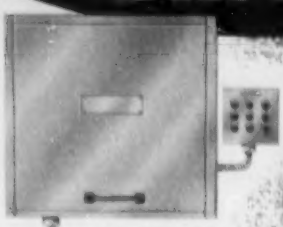
DOUBLE-ENVELOPING WORM GEAR SPEED REDUCERS

DOUBLE REDUCTION WORM GEAR SPEED REDUCERS

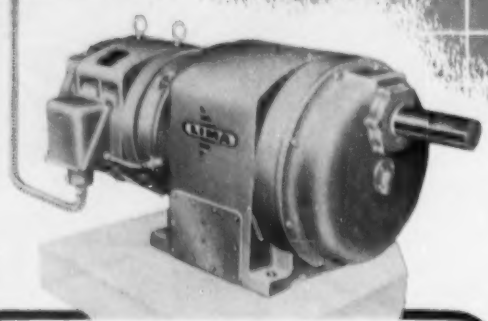
DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS

Circle **10** on Reader Service Card

LIMA
Selectro-Shift
DRIVES



For use on any equipment where large horsepowers are needed and multiple speeds are required.



20HP 25HP 30HP 40HP
with
REMOTE CONTROL PANEL
6 or 3 speed

- incorporates gear sets . . . *no belts!*
- hydraulic clutches activated by electric solenoids.
- can be shifted to any of six speeds *while running under full load!*
- forward or reverse drive.

for additional information, write:
Darrel Bryan
general sales manager

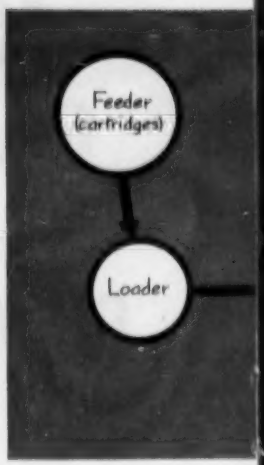
LIMA

- ELECTRIC MOTORS (1 thru 200HP NEMA)
- GEARSHIFT DRIVES
- VARIABLE SPEED DRIVES
- GEARMOTORS
- STRAIGHT LINE REDUCERS
- SHAFT MOUNT REDUCERS
- GENERATORS
- GEAR REDUCERS
- GREEN SEAL MOTORS
  *Unconditionally Warranted

A Member of The Gardner Group

THE LIMA ELECTRIC MOTOR CO., INC.
LIMA, OHIO

Circle **26** on Reader Service Card



Machine loads, fills, plugs, seals, and tests fountain pen cartridges.

Continuous

MORE THAN 250 CARTRIDGES a minute come tumbling out of a cartridge-filling machine. The cartridges are polyethylene tubes filled with ink and sealed at both ends. Each cartridge is 2 in. long and has a 5/16-in. diameter. They are for use with a new type of fountain pen.

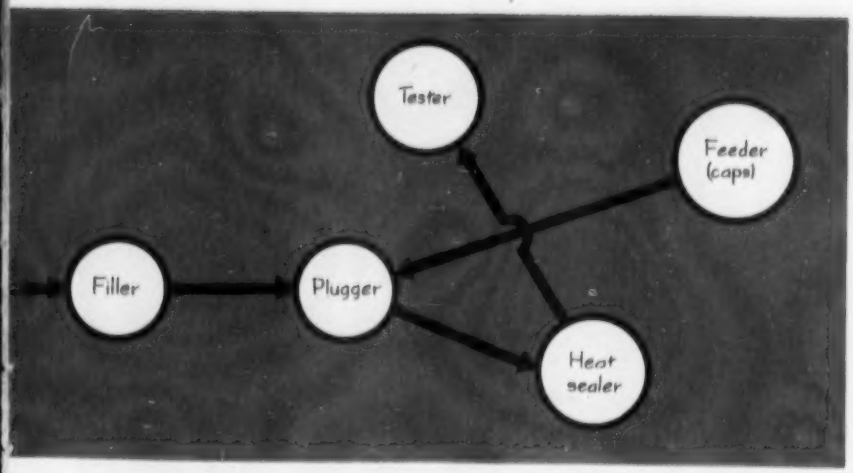
How it works—The flow diagram shows automatic process. Two continuous chains move the cartridges through the steps of the process. One chain drives the manufacturing section of the process. The other chain drives the testing section.

The machine has two vibrating hopper feeds. One hopper contains empty plastic cartridges with one end sealed. The other stores caps for the other ends.

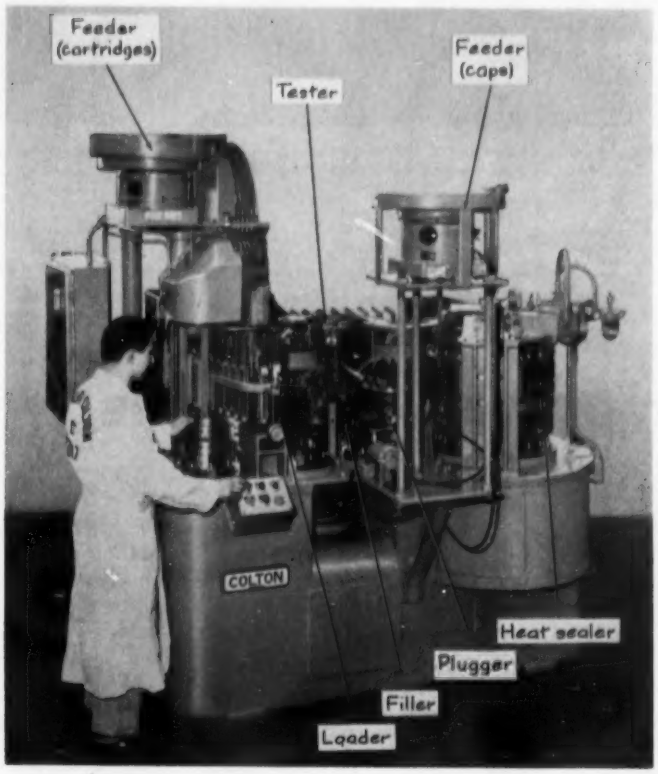
An orienting device receives empty cartridges from the hopper and places them in individual holders of the first continuous chain. The rotary filler then fills them with 1.6 cc of ink. A cam-operated piston pump controls the fill. As the chain moves the cartridges to the rotary plugger, caps from the second hopper also move toward the plugger. Synchronizing these movements makes the cartridge and cap meet at the right time and place for plugging. After plugging, the chain moves the cartridges to the rotary heat-sealer, which seals the cartridges, completing the first part of the process.

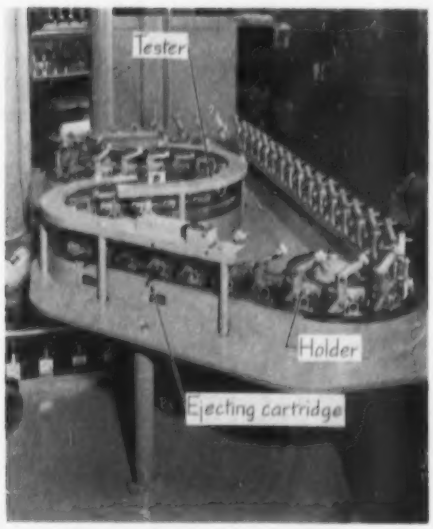
The sealed cartridges move from the heat-sealer to a bank of pneumatic tubes. Compressed air forces the cartridges through these tubes into spring-loaded holders on the second continuous chain. The cartridges move into a tester and are squeezed. Compressed air discharges accept and reject cartridges at points along the chain.

Drive components—A 3-hp, 1800-rpm motor supplies power for the machine. A variable-speed belt drive reduces the speed to 1200 rpm. Then, a 40 to 1



chains drive automatic machine





TESTER RECEIVES CARTRIDGES in spring-loaded holders. After squeeze test, tester ejects good and bad cartridges at points along chain travel.

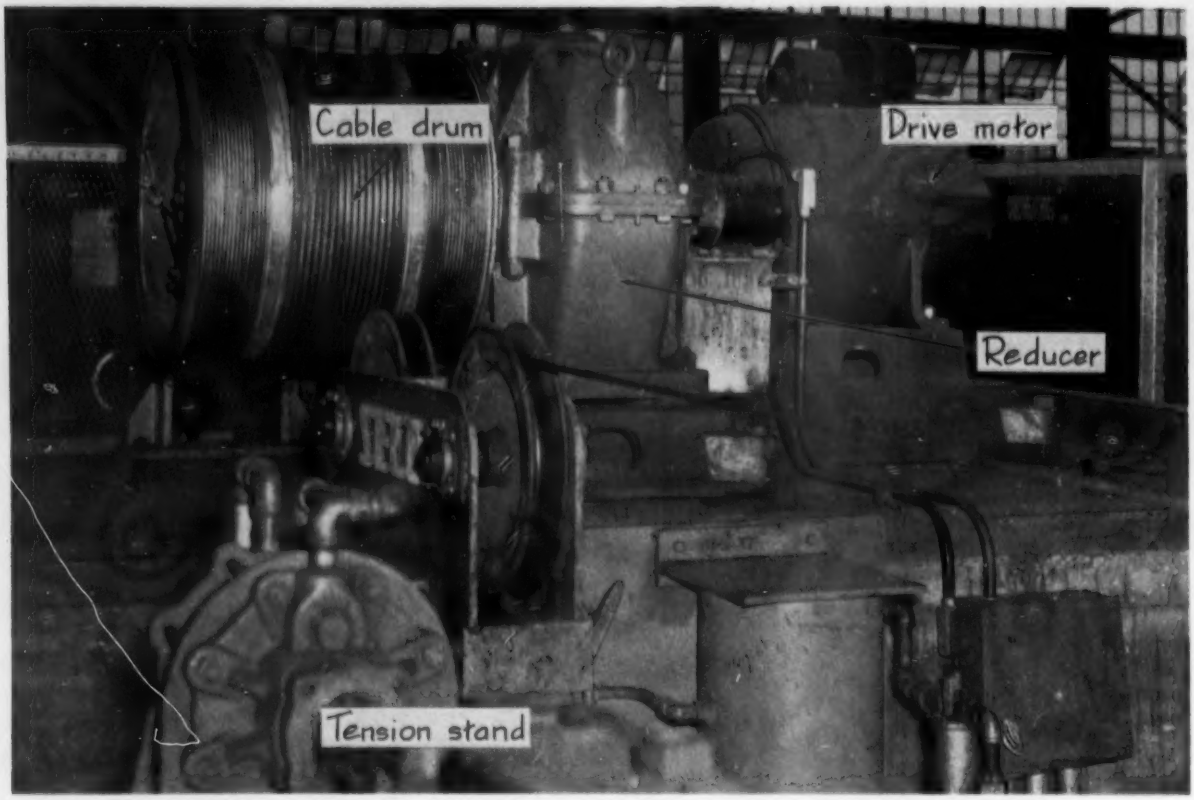
AUTOMATIC PEN-CARTRIDGE FILLER produces 250 cartridges per minute. One continuous chain drives the loading, filling, plugging, and sealing operation. Another continuous chain drives the tester section.

right-angle speed reducer cuts this speed to 30 rpm for the filling process.

An automatic safety clutch disconnects the power if there is an obstruction to the moving system. This helps protect the system from early breakdown. The clutch has a detachable hub to make it easier to replace parts mounted on the clutch-housing flange.

The machine has adjustments for timing all chain stations. An operator adjusts the gears and sprockets to time them relative to the shafts.

Machine is made by Arthur Colton Co., Div. of Snyder Corp., Detroit. ◆



PULLER DRIVE operates through a 2-stage reducer. Cable drum is 30 in. in diameter and has three sections of grooves. Drum has two return cables and a main pull cable. The return cables unwind as the pull cable winds, and vice versa.

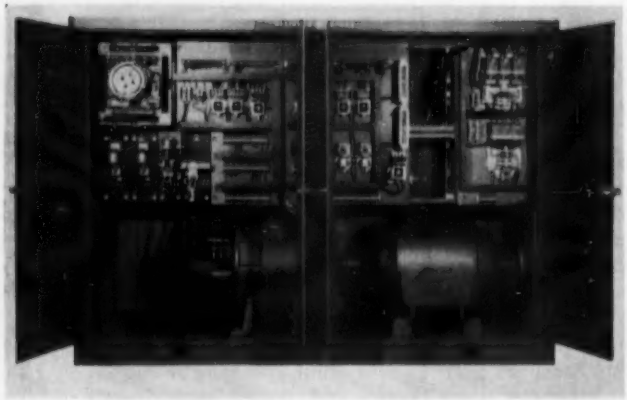
Puller drive improves extrusions

A FULLY AUTOMATIC PULLER DRIVE produces straight extrusions. It operates over a wide variation of products and speed range. The puller clamps the extrusion as it comes through the die. Without the puller the extrusion would be bent. At Dow Chemical Co., Madison, Ill., one operator controls the process from a central operating station.

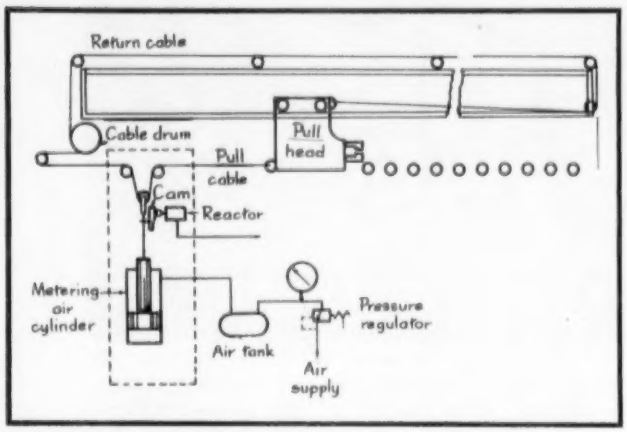
Puller operation—Two distinct cycles comprise the puller-drive operation: pull cycle, and return cycle. An operator starts the pull cycle after the extrusion is clamped in the pull head. The puller applies tension to the extrusion until it is sawed off at the end of the extruding operation.

Then, the operator starts the return cycle. Maximum return speed is about four times maximum pull speed. High return speed is desirable for the nonproductive part of the operation.

Puller system—The puller setup is an integrated electro-mechanical system. An overhead bridge with rails supports and transports the pull head. Main pulling action is between the cable drum, tension stand, and pull head. The tension stand contains mechanical controls for the drive. It has two fixed sheaves and a movable sheave supported by a yoke on the shaft of a metering air cylinder. The cylinder controls the movable sheave to adjust cable tension. The stand also has a cam assembly operating a short-stroke reactor, and a pneumatic regulator system. Cam move-



PACKAGED POWER UNIT has a steel enclosure with a built-in cooling system. It contains electrical controls for the puller drive.



GENERAL ARRANGEMENT of puller system. Pull head clamps extrusion as it emerges from the extrusion die. Mechanical and electrical controls keep the extrusion under proper tension during extrusion operation.

ment affects the reactor which sends information to an electrical control unit.

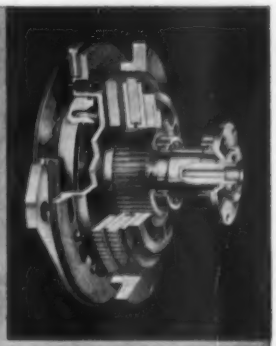
The drive motor has high overload capacity and low inertia. It receives armature power from a packaged power unit.

The power unit contains electrical controls for the drive. It is a compact, variable-speed control unit housing a motor-generator, magnetic control, and regulators. The unit permits the motor armature voltage to swing from a maximum in one direction to a maximum in the opposite direction. This reverses the drive motor at a very fast rate. The regulator circuit balances the system during the pull cycle to give required extrusion at the set value of tension. The cam in the tension stand provides overtravel on both sides of the regulating range. Thus, for transient conditions, the tension will be maintained at a given value. ◆

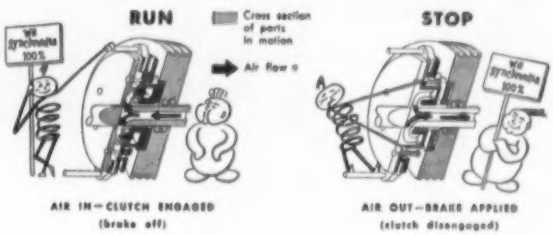
Technical assistance for this article supplied by Reliance Electric and Engineering Co., Cleveland.

For Original Equipment Requirements

MINSTER Combination Clutch and Brake



Air-Operated • Compact
Fast-Acting • Perfectly Synchronized



The Minster patented Combination Air Friction Clutch and Brake unit offers these advantages for original equipment use.

- Controlled single or multiple cycling within a wide range of speeds
- Clutch and brake in single, synchronized unit
- Adaptable to mounting on crank, cam or drive shaft for flywheel or geared applications
- Can be used with flywheel, gear or drive-spider and mounted outboard or between bearings
- Constant or variable clutch torque
- Compact, space-saving, easily installed
- Minster Electrical Controls to your requirements

Write for OEM Clutch Bulletin 16

THE MINSTER MACHINE COMPANY • MINSTER, OHIO

MINSTER®

Circle **29** on Reader Service Card

INTERFEROMETER

Light from a single source is split into two beams. The two beams have equal optical path lengths. One beam passes through a transparent replica of the test surface immersed in liquid. When the beams recombine, they interfere according to their phase relationships. The result is stripes of light and darkness. The contrast between light and darkness is a measure of the out-of-phase relationship, hence, the difference in path lengths traveled by each light wave.

Difference in optical paths of the two beams determine the contour of the surface. Immersing the replica in liquids of various refractive indices gives a wide range of sensitivities.

CAPACITANCE

The test metal is placed in an electrolyte. This makes an electrolytic capacitor—the metal acts as one plate and the ions in solution act as the other plate. Capacity of a capacitor increases as the area of the plates increases. Rough metals will have higher capacitances than smooth metals because they have greater surface area.

A mercury surface is the standard for comparison. A roughness factor is determined by comparing the capacitance of the test metal to capacitance of mercury.

RADIOACTIVITY

Surface areas of rough and smooth specimens are exposed to radioactive gas for a given time. The specimens are cooled and transferred from the radioactive gas. A radiation counter measures the activity of the adsorbed layers. Determining the ratio of the activity of a rough specimen to that of a smooth specimen gives a roughness factor. This can be related to force required to overcome friction.

New ways to measure FRICTION

GEARS, BEARINGS, and other sliding and rolling parts of transmissions work better, the smoother the mating surfaces. Specialists measure surface roughness as the ratio of the true surface area to the calculated geometric area.

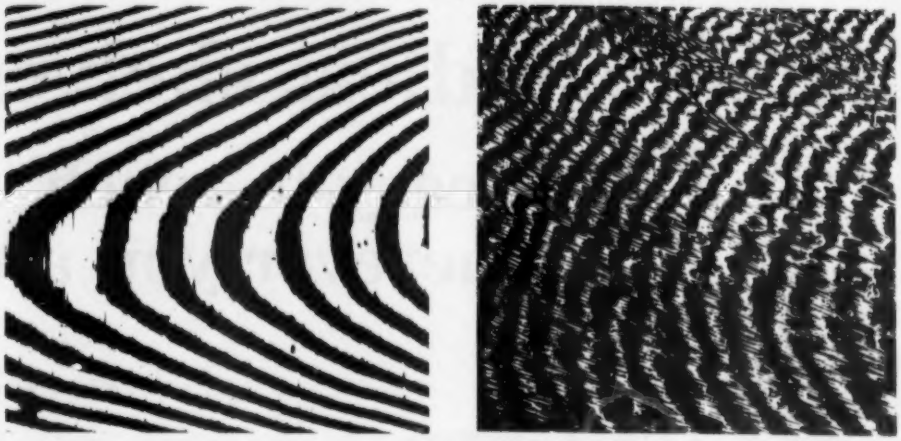
Production costs go up with smoothness, so it's desirable to have a surface roughness measure in order to be able to specify finishes no smoother than the job requires.

A conventional way to measure roughness employs the electromechanical stylus. The stylus traces out a cross section through the test surface in a given plane. A recorder graphs these traces. Potential friction forces exerted by the surface can be determined by analyzing the graph.

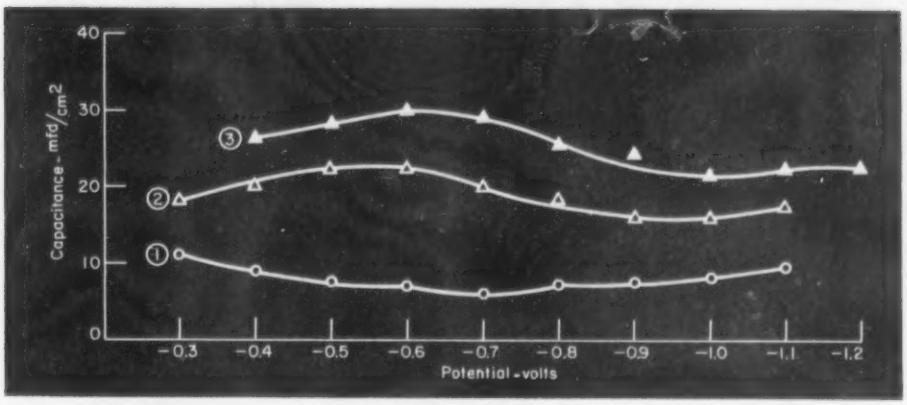
The stylus method is not satisfactory for many applications because it measures only one plane. One trace may be quite different from another on the same material if the surface varies considerably. Taking measurements in many planes helps to increase accuracy, but this is time consuming and costly.

Newer ways to measure roughness—The improved interferometer method employs a transparent replica of the surface. This replica is made from cellulose acetate softened with acetone and pressed against the surface. Surface roughness of the replica diffracts the beam of light which passes through it. There is no interference to the second beam.

An electronic analyzer helps interpret the beam interference pattern by transferring it to a cathode ray



INTERFEROGRAMS of the edge of a smooth disc (left), and the surface of a shaved gear tooth (right). Photos, courtesy Associated Electrical Industries, Ltd., London.



CAPACITANCE CURVES show the relative roughness of stainless steels. Curve 2 is stainless steel finished to 800 grit; curve 3 finished to 240 grit. Curve 1 is for a mercury pool electrode, assumed perfectly smooth.

oscilloscope. This substantially reduces the time required to evaluate average surface roughness.

The interferometer and electronic analyzer offer a convenient and rapid method of measuring roughness. Inaccessibility of the selected area is not a serious disadvantage because replicas may be taken on site in a matter of minutes and sent to the laboratory for analysis. A single interference pattern provides a detailed record over the whole area of the replica. Sensitivity may be varied to cover heights from a few millionths to a few thousandths of an inch.

The polarizaion capacitance method operates on the principle that surface roughness of the plates of a capacitor increases the area of the plates. Rough plates have greater capacitance than smooth plates. In practice, the method assumes that:

1. All metals have the same capacities at comparable potentials.
2. Surface of mercury is ideally smooth.

Roughness factor is equal to the ratio of the respective capacitances, or,

$$\text{Roughness factor} = \frac{\textit{Capacitance per unit geometric area of solid}}{\textit{Capacitance per unit geometric area of mercury}}$$

In the radioactivity method, the surface adsorbs radioactive gas—iodine 131—as it sublimes (passes directly from solid to gaseous state). A rough surface adsorbs more gas than a smooth surface because it has a greater surface area, and the radiation counter will read higher.

Handling of radioactive materials requires special care on the part of the operator. Also, radioactive iodine injures some metals. ◆

ROUGHNESS FACTORS BY USING RADIOACTIVE IODINE

Metal	Surface Treatment	Roughness Factor
Gold	Polished	1.00
Gold	Fine crocus cloth	1.56
Gold	Coarse crocus cloth	2.49
Gold	210 emery cloth	5.73
Yellow brass	Polished	6.68
Yellow brass	Fine crocus cloth	10.90
Aluminum	Mechanically polished	3.09

Bibliography

A.E.I. Engineering Review, Vol. 1, *No.* 3; D. A. Parker and C. K. V. Owen, A.E.I. Research Laboratory, Rugby, England.
Polarization Capacitance Determinations of Surface Roughness; M. K. Testerman, University of Arkansas.
Use of Radioactive Vapor for Determining Surface Roughness; M. K. Testerman, University of Arkansas.

FOR YOUR MECHANICAL POWER TRANSMISSION NEEDS...

industry's handiest shelves

easy-to-reach wherever you are

365 Link-Belt distributors keep industry's machines in motion, materials on the move

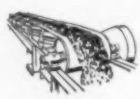
The shelves of Link-Belt authorized stock-carrying distributors stretch from coast to coast. These shelves, backed by Link-Belt's strategically located warehouses, assure ready availability of the world's broadest selection of related mechanical power transmission products. Add to this a complete line of conveying and elevating components and you have the reasons why Link-Belt distributors successfully serve and satisfy customers. See the classified yellow pages of your telephone directory for the name of the nearest Link-Belt distributor. Or write: Link-Belt Company, Dept. BW, Prudential Plaza, Chicago 1, Ill. 15,558

LINK-BELT

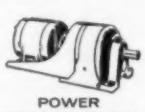
Basic products and engineering for industry's basic work

BEARINGS

CHAINS AND SPROCKETS



CONVEYING EQUIPMENT



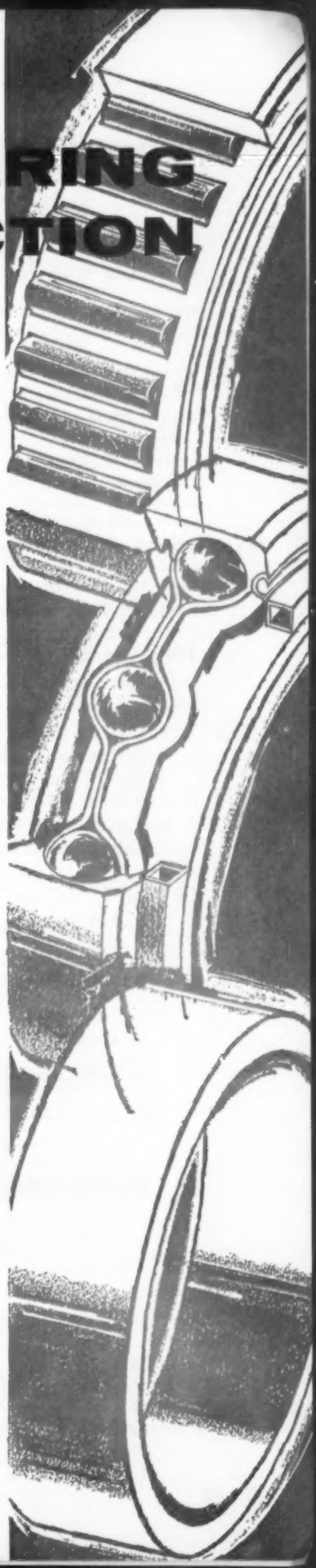
POWER TRANSMISSION MACHINERY

ENGINEERED (PROCESSING) EQUIPMENT

Circle **25** on Reader Service Card

BEARING SECTION

HAROLD BELANGER
bearings editor



Bearing Business

SKF Industries—received a $177,000, 3-year contract from the Navy's Bureau of Weapons for a research study on how lubrication affects bearing life. Radioisotopes, X-ray and electrical conductivity will be used in extreme-environment tests duplicating conditions in rockets, atomic reactors etc. The tests will concentrate on the characteristics of different types of lubricants in the highly-stressed areas (600,000 to 800,000 psi) between rolling element and race.

Hoover Ball & Bearing Co.—formed a subsidiary company, **Forster/-Hoover Electronics, Inc.,** by linking up with the Institut Dr. Forster in Reutlingen, Germany. The new company will manufacture and sell electronic products developed by the Institut, which was founded by Dr. Forster in 1948 as a research and development center. The Institut is well known in Europe and the U. S. for work in non-destructive electromagnetic testing, magnetic field measurement, material research and dimension measurement.

Kaydon Engineering Corp.—announced price reductions of 25 to 42 percent on their Reali-Slim "CP" ball radial bearings. This is the third price reduction since October 1959, when these bearings were first made as a stock item. Kaydon attributes the reductions to voluntary incentive-rate cuts by employees, and to increased productivity.

United Delco wholesalers held a week-long Dealer Fair recently in Charlotte, N. C., to show retailers new Delco merchandising methods. The wholesalers combined efforts and chartered enough buses and cars to bring in all of their key retailers from North and South Carolina, Virginia and parts of Tennessee. Total attendance was put at over 1300 people. The show included a private showing of all of General Motor's '62 cars.

Caste Bronze Bearing Institute's president, **Carter N. Paden, Jr.** presented a paper called "Approach for Research in Grease Lubricated Cast Bronze Bearings," at the Annual Meeting of the **National Lubricating Grease Institute** (held Nov. 1st, at Rice Hotel, Houston).

The paper gave a short description of the work done by CBBI on hydrodynamic and hydrostatic bearing research and on the lubrication of thrust bearings. Results of research to date were broken down point-by-point and proposed lines of development outlined. The Institute will give full details to those interested. Write to: *Mr. Herbert Scobie, Cast Bronze Bearing Institute Inc., PO. Box* 1336, *Evanston, Ill.*

Bearing location can cost less

By **HUDSON T. MORTON,** *Consulting Engineer, Ann Arbor, Mich.*

SAVE MONEY and still get the most from your bearings. All it takes is a little study of proper mounting procedure and accessories.

Specific accessories are available for many ways of mounting bearings. For example, locknuts and lockwashers assure positive location on a shaft. Proloading springs will maintain the axial location. Tapered sleeves and shafts can be used with self-aligning bearings whose axial location is not important. Snap rings offer low-cost alternative methods of securing bearings. And in many cases maximum economy can be achieved—eliminate the accessories altogether.

Three steps to bearing location

The ideal way to fasten a bearing on its shaft can be resolved into three steps.

1. Consider the bearing type. Then select the shaft fit dimensions, its size, and operating conditions. Use tables of standardized fits (References 3 & 6 at end of article).
2. Find the shaft thread dimensions for the specific bearing type and size.
3. Apply the corresponding lockwasher and locknut for fastening the bearing inner ring tight against its shaft shoulder.

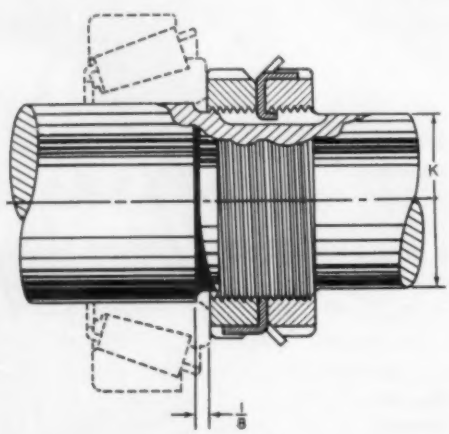


FIGURE 1

To assist the designer in each of these steps, bearing accessory standards have been created to represent the most common uses. Tables are used for ball and cylindrical roller bearings, and tapered roller bearings. On a pair of tapered roller bearings in Figure 1, a locknut adjusts the preload and absorbs the operating load of one bearing. A second locknut, reversed in direction, locks the first. Bending the prongs into each locknut prevents rotation and preload change.

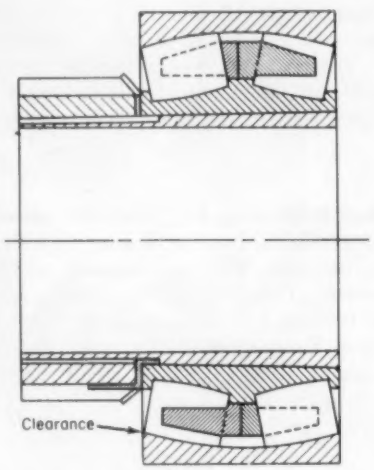


FIGURE 2

For accurate internal fit

Self-alining double-row ball bearings and spherical roller bearings need accurate adjustment of internal fits. The simplest way to fit them is with tapered-bore bearings and adapter sleeves, Figure 2. Tightening the locknut and washer pushes the bearing over the sleeve and closes it, causing it to tighten on the shaft. This device is used also for controlling bearing inner clearance, by expanding the inner ring.

Another way of adjusting internal fit of these bearings uses a tapered shaft identical to the adapter sleeve. Adjustment is made in the same way as with the sleeves.

Using lightly loaded bearings?

Bearings under light load often require no accessories for fastening on the shaft. In such cases an interference fit holds the bearings in place. For proper movement, the bearing rotating ring should have an interference fit with the revolving part and the stationary ring a sliding fit. Electric motors, gear assemblies, and axles have a revolving shaft with an

interference shaft fit. The housing fit is loose enough to slide when the shaft changes length due to heat. Where wheels revolve on stationary axles, such as

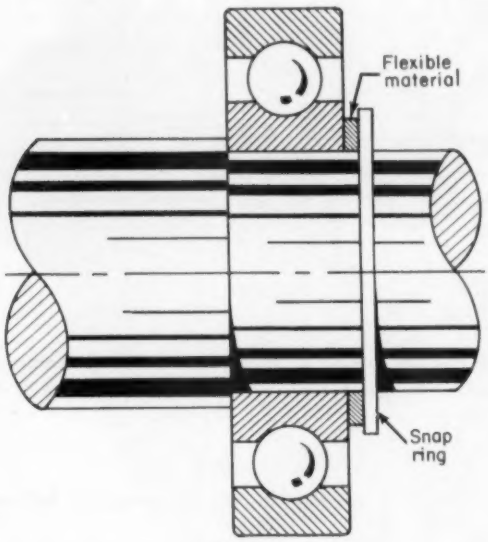


FIGURE 3

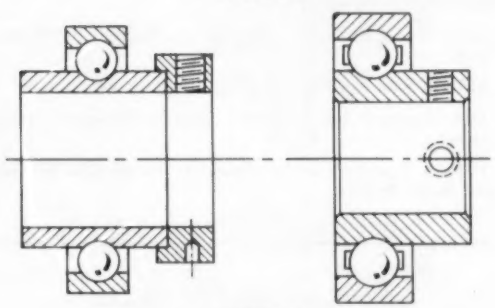


FIGURE 4

automobile front wheels, and loose pulleys, the bearing outer ring usually has an interference fit in the housing and loose fit on the shaft. The inner ring slides into position during assembly.

Here are some alternative methods of fastening lightly loaded bearings.

- Snap rings are used to hold the bearing against its shaft or housing shoulder (Figure 3). Flexible material between ring and bearing absorbs tolerance effects. The interference fit is used here to prevent slippage of the bearing bore or OD.
- Pillow block bearings are used on conveyor-line shafts and non-precision applications. Since the shafts have no shoulders, special fastening devices hold the bearings in position. Figure 4 shows the eccentric collars and the set-screw fastening methods. Other mountings were described in "Users Guide to Bearing Mounted Units" (PTD Aug., p. 44). Both bearings have extended inner rings to permit greater longitudinal contact with the shaft.

Housing mounting . . . in Figure 5 an electric motor is shown with bearings that are held on the shaft by locknuts and lockwashers. The right bearing is fixed between the cover plate and housing shoulder. The left bearing "floats" in the housing. To eliminate costly accurate shoulder locations, many housings are made without shoulders. To locate the fixed bearing accurately, small assemblies used bearings with flanges on their outer rings. Bearings are held against the housing face by the cover plate. Large assemblies use snap rings. Snap rings can also be used where cover plates are not required.

Accurate bearing location on a shaft

Many mechanisms require precise shaft alinment where only rotation is desired with no end play. If

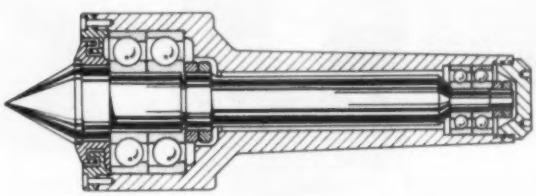


FIGURE 5

the bearings are mounted with minimum housing and maximum shaft tolerances, or if shaft temperatures are higher than housing temperatures, then bearing thrusts cause irregular movement. Preloading offsets these effects. Electric motors and generators need accurate shaft location relative to the bearing housing. However, high precision preloaded pairs of bearings are not used because of motor speeds. Simpler preloading devices have been made.

Bent finger-type springs shown in Figure 6 are placed between the housing shoulder and bearing outer ring. This removes end play from both bearings

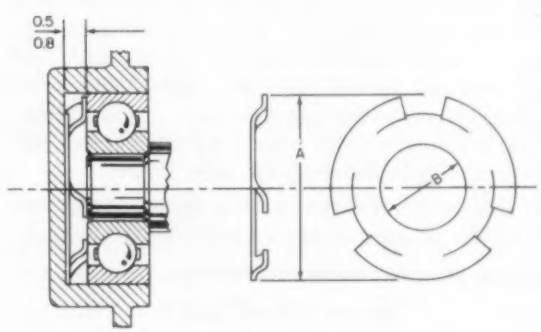
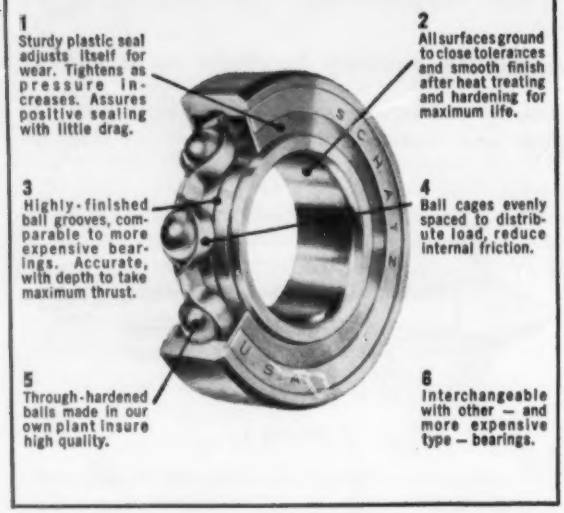


FIGURE 6

and exerts a slight preload of each of them. The load keeps all balls in contact with the raceways, and the shaft locates radially and axially to minimize vibra-

How do the Ball Bearings you use measure up at these 6 important check points?


1
Sturdy plastic seal adjusts itself for wear. Tightens as pressure increases. Assures positive sealing with little drag.
2
All surfaces ground to close tolerances and smooth finish after heat treating and hardening for maximum life.
3
Highly-finished ball grooves, comparable to more expensive bearings. Accurate, with depth to take maximum thrust.
4
Ball cages evenly spaced to distribute load, reduce internal friction.
5
Through-hardened balls made in our own plant insure high quality.
6
Interchangeable with other — and more expensive type — bearings.
SCHATZ
U.S.A.

These 6 check points of Schatz "Functional Precision" bearing performance have proved out — and saved thousands of dollars—for many of the best known manufacturers of power lawn mowers, home laundries, home workshop equipment, farm machinery and others. They can do the same for your product, because

Schatz "Functional Precision" ball bearings provide all the precision you require—and need to pay for—under certain ratios of loads, speeds and life expectancy.

Their solid one-piece inner and outer races are machined from high quality steel. They are available in open type, single or double shielded; single or double sealed; with one shield and one seal. All double shielded and double sealed types are prelubricated. Bearings with snap rings, set screws, extended inner rings or special dimensions and tolerances may be had on special order.

Let us show you how these cost-saving bearings fit your production program. Write for Catalog 12.

The Schatz Manufacturing Company, 7640 Fairview Ave., Poughkeepsie, N. Y.

See our ad in SWEET'S

SCHATZ
"Functional Precision"
BALL BEARINGS

Circle **33** on Reader Service Card

tion and noise. The floating housing permits axial sliding of the bearing as the shaft length changes.

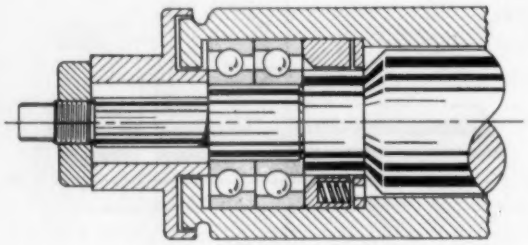


FIGURE 7

Belleville springs (Figure 7) mount the same as bent-finger springs, but can mount in any quantity to obtain heavy preloads when required. ◆

REFERENCES

1. AFBMA Standard No. 7. Bearing Mountings for Ball and Roller Bearings.
2. ASA Standard No. B3.8-1960. Bearing Mounting for Ball and Roller Bearings.
3. Anti-Friction Bearings Textbook. By Hudson T. Morton, 1954.
4. AFBMA Standard No. 8. Bearing Mounting Accessories.
5. ASA Standard No. B3.9-1960. Bearing Mounting Accessories.
6. AFBMA Standard No. 2. Boundary Dimensions for Ball and Roller Bearings.

RECENT BEARING ARTICLES

This list shows some of the bearing articles which appeared recently in POWER TRANSMISSION DESIGN. If you missed them, we can supply a limited number of tear sheets

HERE'S WHERE TO USE GREASE ..... **May '61**
By L. J. Bradford, E. M. Barber, J. R. Muenger
Research results show where and when to grease lubric-journal bearings.

APPLICATION TIPS FOR SPLIT NEEDLE BEARINGS .... **June '61**
By Richard Smith
You can use split needle bearings on many jobs once reserved for split sleeves

WHICH BEARING WAS THAT? ..... **Sept. '61**
By R. M. Mansfield
What to do and what not to do, to identify a bearing after failure

Reprints available. Prices: 1-24 copies, 15c each
Over 25 copies, 10c each

USER'S GUIDE TO BEARING MOUNTED UNITS ..... **Aug. '61**
By Harold Belanger
What they are, types, where they are used

TFE TAPE LINED BEARINGS ..... **Oct. '61**
Some of the uses types and advantages of filled Teflon-resin bearings

Now...

A complete line of gearmotors from 1/1500 h.p. to 15 h.p.

(.005 R.P.M. to 3600 R.P.M.)

The combined engineering talent and manufacturing facilities of Holtzer-Cabot and Janette now bring to industry the most complete line of gearmotors available from a single source.

Sub-fractional, fractional, and integral horsepower motors are available with a wide range of gear reduction ratios in helical, worm, spur, planetary, and combination drives. Thus, almost complete freedom from compromise is possible in selecting equipment to be integrated in machine design, or for plant installation.

You'll find a Holtzer-Cabot or Janette representative or distributor listed in the yellow pages of your phone book. He's your best bet for the solution to any problem involving the use of speed reducers or gearmotors.

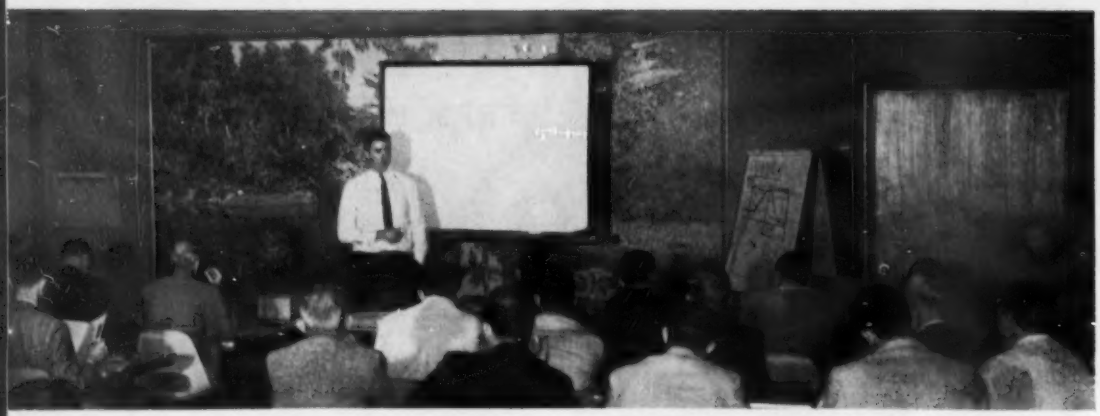
HOLTZER-CABOT AND JANETTE DIVISIONS
NATIONAL PNEUMATIC CO., INC., 125 Amory St., Boston 19, Mass.

HOLTZER-CABOT ESTABLISHED 1875

Janette GEAR MOTORS MOTORS SPEED REDUCERS

Circle **23** on Reader Service Card

Free maintenance school for bearing users



An idea that promises to be of great benefit to bearing users has been introduced by a leading bearing manufacturer. The idea seems so good that it well may spread to all bearing manufacturers.

Fafnir Bearing Co. runs a free maintenance training school for supervisory maintenance people. At first, classes were designed for training distributors' salesmen. The results were so good they they have now steamed ahead with a full program for distributors' customers. Chief Instructor J. T. H. Eaton prepared a full day's course on bearing maintenance, using movies, slides, mobile displays and so on. The course covers:

- Manufacturing
- Types of bearings and applications
- Numbering systems
- Preventive maintenance

But, manufacturers found that they couldn't spare their men for a full day. So, Eaton redesigned the course to take 3 or 4 hours. It can now be arranged for morning, afternoon, or evening, to suit the particular needs of the "pupils."

Classes usually consist of about 25 to 50 people meeting in a hotel or restaurant. They represent the larger bearing users in the area. The schoolteacher's chief job is to draw out questions and comments from the group. He covers such subjects as lubrication and lubricants, bearing tools, power transmissions, and so on.

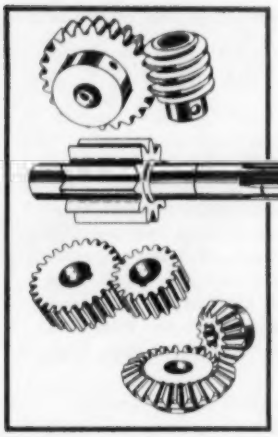
Although Fafnir provides the instruction, the distributors sponsor the school. They arrive, eager to promote sales—and not only Fafnir bearings. This can be very valuable to the user because it gives him a chance to compare the various types. The instructor, being factory trained, encourages the class to buy only from company-authorized distributors. The distributors try to meet the class informally, say during coffee breaks.

The classes have been very successful. The company reports that during the first 10 months of the program, they have talked to more than 3000 men, representing 650 leading industries.

The schools are planned to cover all areas where Fafnir bearings are sold. ◆

Maintenance program features a special manual on how to prevent ball-bearing failures. It covers these topics:

- Fatigue failure
- Contamination
- Brinelling
- False brinelling
- Thrust failure
- Misalinement
- Electric arcing
- Lubrication failure
- Cam failure
- Proper tools



If you use GEARS

Find Out How MICRO'S 2 Way Service Solves Your "GEARACHES"

Efficient gear performance demands skilled design—and accurate manufacture. To help you in both these important areas, MICRO has developed a unique service that combines production facilities with engineering know-how to give you **better gears for better performance.** Whether you buy gears or make your own, it will pay you to investigate this unique gear service.

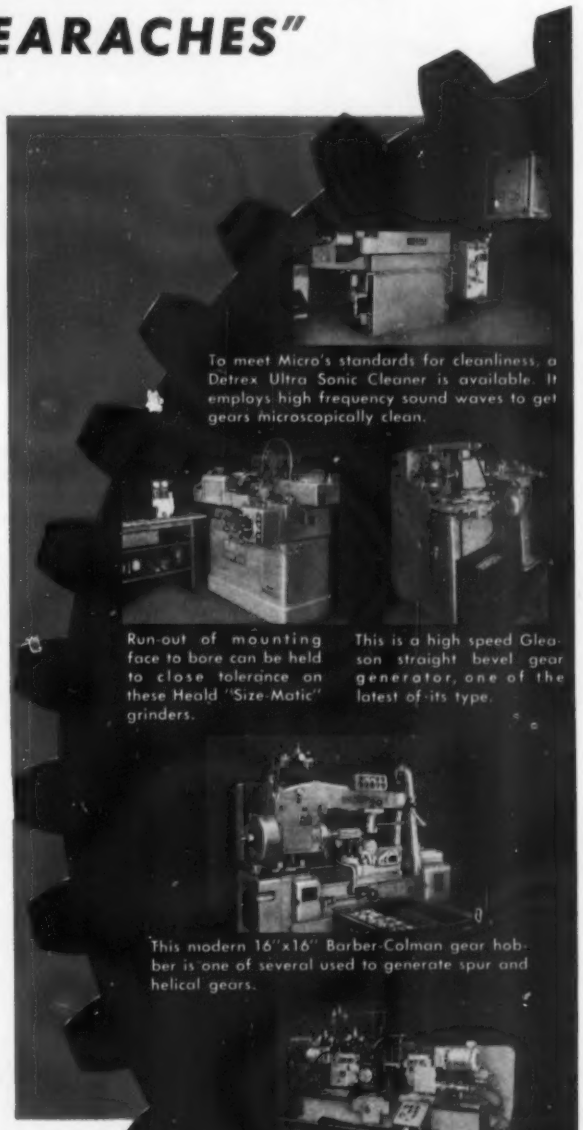
1. *MICRO Production Facilities*

14,000 square feet of production space is devoted exclusively to the production ot gears at MICRO. A few of the specialized machines in use are illustrated here. These modern machines combined with rigid inspection have resulted in a customer rejection rate averaging less than one-tenth of one percent over the last five years. If you need 100 or 100,000 gears a week, you can count on MICRO to deliver on schedule because of accurate production control. Most important of all, efficient production machines and methods reduce unit cost and improve quality.

2. *MICRO Engineering Know-How*

Whether you are designing a new product . . . or improving an existing one . . . MICRO'S free engineering service can help you solve problems. You can ask for and get experienced engineering help from MICRO'S staff of gear specialists. It's more than just lip service from a clever salesman — you can expect real help based on the analysis of your loads, speeds and type of service. MICRO gear specialists will help you design gears, select materials, set tolerances, and design mountings. They can advise on assembly or handling problems and many times suggest design changes that will cut costs and improve quality.

Gears are MICRO'S only business. Only specialists can give you this two fold gear design and production assistance. If you want to cut cost and make your product perform better — MAKE MICRO YOUR SOURCE FOR GEARS!



To meet Micro's standards for cleanliness, a Detrex Ultra Sonic Cleaner is available. It employs high frequency sound waves to get gears microscopically clean.

Run-out of mounting face to bore can be held to close tolerance on these Heald "Size-Matic" grinders.

This is a high speed Gleason straight bevel gear generator, one of the latest of its type.

This modern 16"x16" Barber-Colman gear hobber is one of several used to generate spur and helical gears.

Designed and built by Micro, this automatic centering machine is typical of the specialized equipment used.

WRITE FOR NEW BROCHURE

To find out more about this new approach to gearing problems send for MICRO'S new 8-page, fully illustrated folder. It's free . . . write today!

Spur • Helical • Bevel • Worm • Worm Wheel
Sprockets • Ratchets • Splines • Irregular Shapes

MICRO PRECISION GEAR & MACHINE CORP.

designers and manufacturers of fine and custom pitch gears

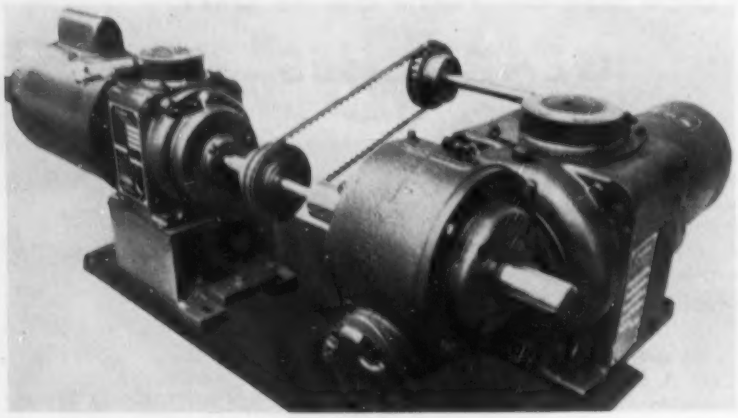
1737 EAST 30TH STREET • CLEVELAND 14, OHIO
TELEPHONE: CHerry 1-6678

Circle **47** on Reader Service Card

PRODUCT NEWS

Speed control system

Infinitely-variable closed-loop system holds speed exactly under widely varying load conditions.



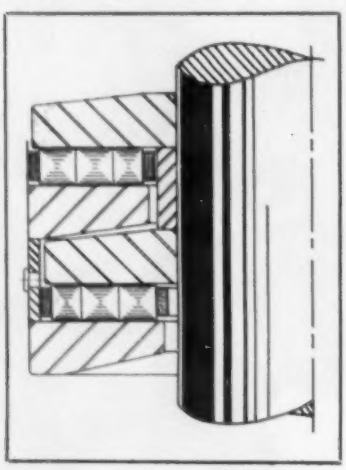
Small infinitely-variable transmission drives directly to a differential for the speed reference. A second driver transmission carries the load and provides the second input to the differential. When driver speed matches reference speed, output is nil. When the two speeds do not match, the differential provides an output to adjust the speed setting of the driver to match reference speed.

Use of a small, precise transmission for the reference increases precision control of the large driving transmission. In the system shown, the differential is directly coupled to the reference drive output shaft and to one of the two driver shafts. The differential case is belt-connected to the driver-transmission speed control. *Graham Transmissions Inc., Menomonee Falls, Wisc.*

Circle **200** on Reader Service Card

Tandem thrust bearings

Multiple stage, for large thrust loads, and limited space.



Two-stage bearing shown is 42 in dia., weighs 5000 lb, has capacity of 4,810,000 lb (based on 500 hours life at 33 ⅓ rpm). First stage takes 2,500,000 lb, the second 2,310,000 lb, and a third stage would add 1,705,00 lb. The cantilevered plates and correlated thickness and length of spacer sleeves distribute the load evenly between roller assemblies. For even greater capacity, add more stages. *Rollway Bearing Co., Inc., Syracuse, N. Y.*

Circle **201** on Reader Service Card

Fluorosilicone greases

Highly stable, solvent-resistant, with wide temperature span.

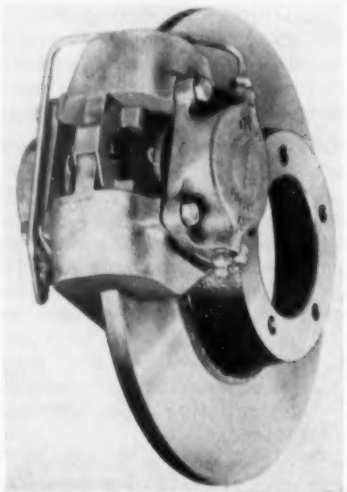
FS 1290 and FS 1291 greases are essentially fluorosilicone fluids thickened with lithium soap. They remain serviceable as low as −50 F, which causes most solvent-resistant greases to solidify. They have no effect on most types of rubber seals. Suitable for all types of bearings. *Dow Corning Corp., Midland, Mich.*

Circle **202** on Reader Service Card

Caliper disc clutches and brakes

British Dunlop Co.-patented design. For industrial uses.

Main feature is the opposed-piston design of the caliper which applies balanced pressure on opposing friction shoes. This permits caliper and disc to be fixed. A retractor pin assembly automatically adjusts clearance between shoes and disc. To replace linings, the



keeper plate—attached by one nut and bolt—is removed, and worn shoes lifted out. Torque range depends on size of calipers and discs or on number of calipers to a disc. Single caliper models now available have maximum torque ratings from 9700 to 54,000 in.-lb at 1000 psi. *Fawick Airflex Div., Fawick Corp., Cleveland, Ohio.*

Circle **203** on Reader Service Card

The READER SERVICE CARD is on page 50. Use it to get information quickly on any of these items

Wound rotor motors

Redesigned to NEMA frame sizes 213 through 326U

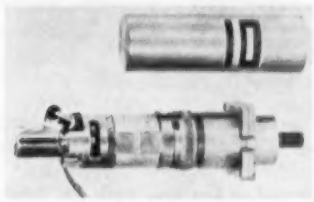
Sizes from 1-30 hp, with a substantial reduction in size and weight over earlier models. Open, drip-proof or totally enclosed, non-ventilated enclosures for horizontal, side or ceiling mounting. *Louis Allis Co., Milwaukee, Wis.*

Circle **204** on Reader Service Card

Servo motor with tachometer

For transistorized servo systems

Combines permanent magnet dc motor with planetary gear reducer and a dc rate tachometer. Pro-



duces torques of over 10 in.lb through a speed range of 1 to 15 rpm. Feedback is 8 vdc per 1000 rpm. Tachometer feedback information controls wide speed

Circle **45** on Reader Service Card

Angular Drive Design

Made Possible with

AJAX Dihedral Couplings with a wide range of angular and offset capacities provide smooth running angular drives with constant peripheral speeds in minimum space. Results include compact size, improved performance, elimination of breakdowns and reduced maintenance cost. Write for performance data.

AJAX

FLEXIBLE COUPLING CO. INC.
132 Portage Road
WESTFIELD, N. Y.

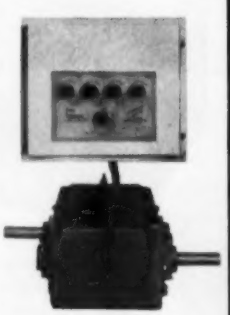
DIHEDRAL COUPLINGS

Representatives in Principal Cities

See Yellow Pages

PIONEER IN MULTI-SPEED TRANSMISSIONS

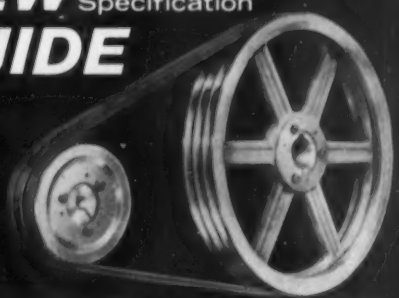
Turner transmissions are as modern as automation! Hundreds of ratios catalogued and available from stock. All transmissions are now available for vertical shaft installation and with reversing. Flexible shaft locations on order. 2-3-4-6-9 speed units available in 2 to 75 H.P. Pictured is the new automatic transmission.



TURNER UNI-DRIVE CO.
3416 TERRACE ST. • KANSAS CITY 11, MISSOURI

Circle **38** on Reader Service Card

NEW GUIDE Engineering and Specification



FORT WORTH
MULTIPLE V-BELT DRIVES
Using QD SHEAVES

with interchangeable tapered split bushings. Quick, easy installation and removal. Positive press fit. Same bushings used in Fort Worth QD Sprockets. New 64-page bulletin includes complete data for selection of stock and non-stock multiple V-belt drives, and specifications of A, B, C, and D section sheaves and V-belts. Ask your Fort Worth Distributor for free Catalog Section 50-C, or Write to Dept. PTD, Fort Worth Steel & Machinery Co., Fort Worth 1, Texas.

Circle **16** on Reader Service Card

PRODUCT NEWS

ranges. All reducer bearings are anti-friction type. Components can be matched for whatever values needed. *Globe Industries, Inc., Dayton 4, Ohio.*

Circle **205** on Reader Service Card

Friction material

New organic friction material almost eliminates high temperature fading.

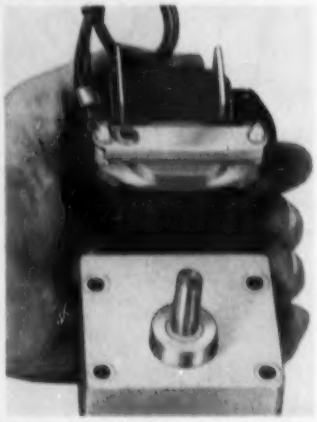
Positive control of brakes and clutches up to 1000 F, with high loads and fast cycling is possible

with material J-M Style No. 160. Average coefficient of friction is .56 at 350 F, .62 at 600 F and .53 at 1000 F. The material is rigid, molded and contains zinc particles. Made in blocks, facings and sheets. *Johns-Manville, New York, N. Y.*

Circle **206** on Reader Service Card

Fhp gearmotor

Develops 30 in. lb torque. Choice of three different motors.

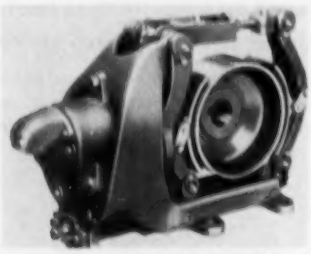


New WF gearmotor puts out 100 to 120 percent starting torque. Model shown has a two-pole, shaded-pole, unidirectional induction motor. Gear case is a non-ferrous reinforced casting. Hardened spur gears. Shaft can be extended from either side of the case. Power is 115 vac, single phase, 60 cycle. Available with brake, fan, special leads, thermal protector, and shaft modifications. *Merkle-Korff Gear Co., Chicago, Ill.*

Circle **207** on Reader Service Card

DC magnetic brake

Shoe-type 8-in. brake built to AISE-NEMA standards

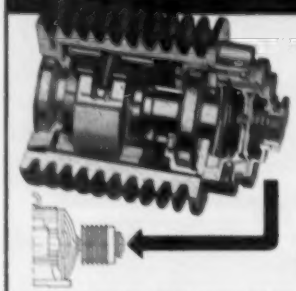


The Bulletin 106 Type B brake has a removable magnet coil for on-the-job repairs. The magnet is hinged at the top, with the widest part of the air gap at the bottom, to allow dirt to fall through. Coils are epoxy encapsulated. The "nut cracker" design assures equal pres-

Continued on page 51

NOW . . . S-M-O-O-T-H STARTING

POWER-MAX®



THE CLUTCH THAT THINKS

Exclusive adjustable acceleration and torque-limiting features

Even if you've used many other centrifugal clutches without success, **POWER-MAX** may easily solve your clutch troubles!

This unique power transmission device is an automatic centrifugal clutch with self-contained hydraulically controlled adjustable time delay, controlled acceleration and adjustable torque selection and control. It saves power; neither motor nor control need be oversize for starting loads. It protects both drive and driven mechanism against overload, "jamming" and damage.

For both electric and internal combustion engine drives. **POWER-MAX** is available in sizes from 3 to 2000 hp in direct, v- or flat belt types and for chain and other drives.

Put a single **POWER-MAX** to work on your toughest drive application! Join our satisfied users who call **POWER-MAX** the "most important power transmission development in years."

For detailed literature and engineering data, write today.

OLME PRECISION, INC.

Box 1067-C. . . Portsmouth, Ohio

Circle **31** on Reader Service Card

NOW . . . you can get LOW COST

DARCO SPROCKETS

A.S.A. 35, 40, 41, 50

Standard types from stock. Special types and designs at low cost . . . fast delivery.

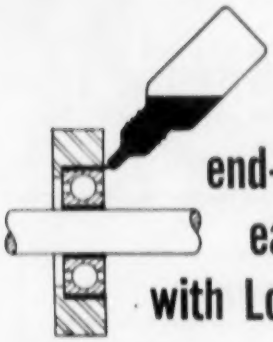
Write for DARCO SPROCKET CATALOG No. 2 or send specs on special sprockets for prompt quotation.

DAYTON ROGERS *Manufacturing Company*

Minneapolis 7Z, Minnesota

Circle **12** on Reader Service Card

Circle **1** on Reader Service Card



Loose-fitting end-bell bearings easily repaired with Loctite sealant

2¢ worth of Loctite Sealant, the plastic that acts as a "liquid shim," restores bearing fits in electric motor end-bells. Just a drop or two of Loctite on both bearing and housing does the job in minutes. Eliminates need for reboring, sleeves, shims, metallizing. Bearings mounted with Loctite can be removed with ordinary bearing removal tools. Comes ready to use. No mixing.

Call your distributor, or write us for literature and free sample

LOCTITE® SEALANT

AMERICAN SEALANTS COMPANY
457 N. Mountain Rd., Hartford 11, Conn.

Circle **2** on Reader Service Card

ROTO-GUARD
MOTION INDICATOR

SHAFT MOTION INDICATOR
PROTECTS MACHINERY BY INDICATING STOPPAGE DUE TO OVERLOADING OR MALFUNCTION

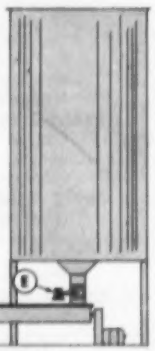
A and B: On end return idlers, warn if conveyor should break, slow or stop.

C: On boot pulley, signals slowdown, stoppage, slippage due to overload, boot pulley out of adjustment. Helps prevent fires.

D: On screw conveyor, warns of slowdown due to overloading. Prevents damage.

E: On rotary feeder, warns of slowdown; prevents plugging damage.

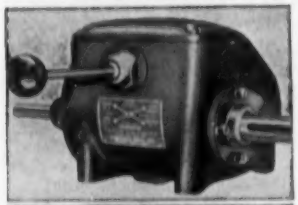
Roto-Guards can be wired into interlock system; stoppage of one component automatically stops others; prevents damage.

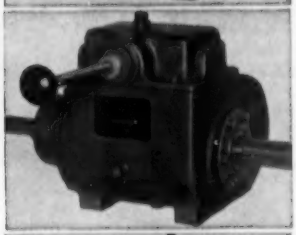


Write for Bulletin RG-21 or call TUxedo 2-5000

THE BIN-DICATOR CO.
17190-83 Denver • Detroit 24, Mich.
We Sell Direct • Phone Orders Collect

TRANSMISSIONS *featuring* Electro-Magnetic Control





9000-B (1-10 H. P.)
TORQUE RATING:
1400 pound inches output
350 pound inches input
HORSEPOWER RATING:
5 H.P., 900 r.p.m. input
10 H.P., 1800 r.p.m. input
GEAR RATIOS:
1:1—2:1—3.14:1—4:1
Special ratios at extra cost
Maximum Reduction 5.07:1

9100-B (10-20 H. P.)
TORQUE RATING:
700 pound inches input
2800 pound inches output
HORSEPOWER RATING:
10 H.P., 900 r.p.m. input
20 H.P., 1800 r.p.m. input
GEAR RATIOS:
1:1—2:1—3:1—4:1
Special ratios at extra cost.
Maximum Reduction 6.00:1

14800 (left)—Four special speed changes up to limit of case 10:1

14900 (left)—Four speed changes in geometric progression at 1.71 (total reduction of 5.03)

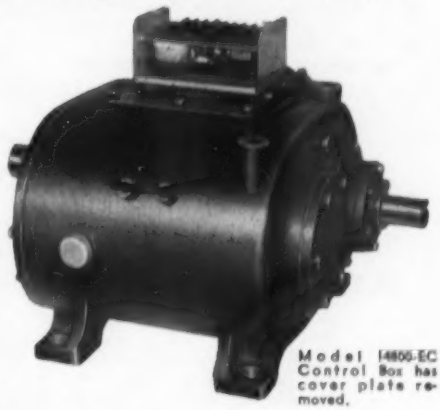
TORQUE RATING:
1400 pound inches input
7500 pound inches output
HORSEPOWER RATING:
20 H.P., 900 r.p.m. input
40 H.P., 1800 r.p.m. input

Transmissions with Electro-Magnetic Clutches provide speed changes and reversing under power, without interrupting power source . . . so equipped are available with two to eight speeds, capacities from 52 to 750 foot pounds and a wide ratio selection (up to 10:1). Manual or automatic controlling of speed changes accomplished with electric switches, tape, cam or other remote control means available. Especially adaptable to automatic machinery where transmission is not accessible to the operator.

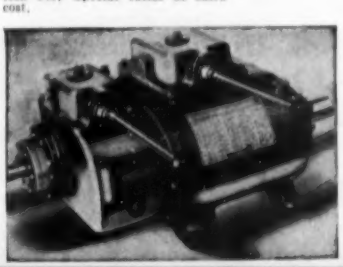
9300 (30-60 H. P.) below

TORQUE RATING: 2100 lb in. input; 12,000 lb. in. output.

H.P. RATING: 30 H.P. at 900 R.P.M. 60 H.P. at 1800 R.P.M. Eight Speed Changes in geometric progression of 1.29 (total reduction 6:1) Special ratios at extra cost.



Model 14800-EC Control Box has cover plate removed.



Transmissions both standard and specially engineered for industrial and agricultural machinery, automotive trucks, tractors, refuelers, industrial shovels, cranes, shop and lift trucks, concrete mixers, road builders, diamond drills, machine tools . . .

Send for catalog and complete information

WESTERN TRANSMISSIONS
WESTERN MANUFACTURING CO. — 3400 SCOTTEN AVE. — DETROIT 10, MICHIGAN

Circle **44** on Reader Service Card

FREE REFERENCE MATERIAL

FROM THIS MONTH'S ADS

You may obtain any of these reference materials by circling the numbers on the reader service cards

1. **PLASTIC BEARING SEALANT**—American Sealant Co.—You can make loose end bell bearings fit with 2c worth of Loctite. Eliminates reboring, shims, sleeves. Literature and sample.
2. **SHAFT MOTION INDICATOR**—Bindicator Co.—Indicator protects machinery by warning of slowdown or stoppage. Shows if stoppage due to overloading or malfunction. Bulletin RG-21.
4. **TRANSMISSION EQUIPMENT**—Charles Bond Co.—Stock components or custom units to specification. Catalog No. 100.
6. **DRIVE TENSIONERS**—Brewer Machine & Gear Co.—360 degree takeup for chain and belt drives stops vibration or slippage. Write for details.
7. **CUSTOM GEARS, BOXES**—Cincinnati Gear Co.—Custom components assure dependability, meet specs exactly. Send for brochure.
8. **ROLLER CHAIN DRIVES**—Cullman Wheel Co.—Write for literature on drives, sprockets, roller chains and flexible coupling.
9. **TEMPLATE KIT**—Crown Gear Co.—Eighteen right-angle units are shown full scale on 6 template sheets. Quick solutions to right-angle design problems.
10. **RIGHT ANGLE GEARMOTORS**—Cone-Drive Gears—Compact, hollow shaft gearmotors give 27 output speeds from 7.3 to 525 rpm, come in ¾ to 40 hp. Catalog 58 for specs.
11. **OVERLOAD SAFETY DEVICES**—Dalton Gear Co.—Prevent breakdowns from jamming with easily-adjusted torque-limiting device. OSD Catalog 961.
12. **SPROCKETS**—Dayton Rogers Mfg. Co.—Standard and special types at low cost. Write for Catalog No. 2.
13. **V-BELTS**—Durkee-Atwood Co.—Catalogs on Positive Drive belts, variable speed belts, multiple V-belts, industrial V-belting, and special types.
16. **MULTIPLE V-BELT DRIVES**—Fort Worth Steel and Machinery Co.—New engineering and spec. Catalog Section 50-C has complete data on multiple V-belt drives, and A, B, C, and D sheaves and belts.
19. **SMALL GEARING**—Gear Specialties, Inc.—Precision internals and many other types covered in Small Gearing Guide. Has useful charts.
20. **UNIVERSAL JOINTS**—Gray & Prior Machine Co.—Fifteen sizes in steel for all requirements. Also made in bronze, monel and other metals. Send for illustrated catalog.

OFFERED FOR THE FIRST TIME . . .

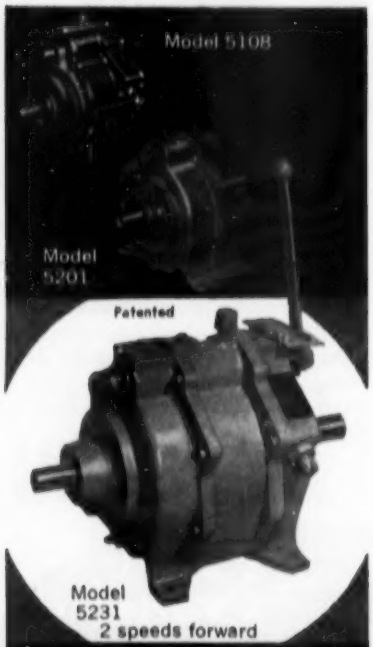
The services and reference materials listed here are being offered by advertisers to readers for the first time

13. **CHAIN, SPROCKETS**—Diamond Chain Co.—Finished steel roller chain, sprockets and flexible shaft Hi-Cap couplings described in Catalog No. 760.
15. **SMALL AIR CLUTCHES**—Fawick Airflex Div.—Standardized air clutch packages, priced for low-cost modernization of small-hp cyclic machines. Send for info.
23. **GEARMOTORS**—Holtzer-Cabot and Janette Div., National Pneumatic Co.—Complete line of gearmotors from 1/1500 hp to 15 hp, at .005 rpm to 3600 rpm. Send for details.
31. **CENTRIFUGAL CLUTCHES**—Olme Precision Inc.—Clutches have self-contained adjustable hydraulic time-delay, plus torque selection. Send for literature.

21. **VARIABLE SPEED DRIVES**—Gerbing Mfg. Corp.—Variable speed pulley-and-belt drives available fractional through 25 hp. Catalog 660.
22. **AIR BRAKES**—Horton Mfg. Co.—Pancake design, mount anywhere, forced draft cooling. Three low-inertia models handle up to 4300 in. lb. Send for brochure.
24. **CLUTCHES AND BRAKES**—Carlyle Johnson Machine Co.—Floating disc feature cuts out drag and abrasion. Capacities to 15 hp at 100 rpm. Send for bulletin.
25. **ELECTRIC DRIVES**—Lima Electric Motor Co.—20, 25, 30 and 40 hp, with remote control panel, for 6 or 3 speed. Write for info.
28. **TOOTHED BELT DRIVES**—Maurey Mfg. Co.—Positive Drives offer slip-proof transmission, a wide range of speeds and hp in compact size. Catalogs.
29. **AIR CLUTCH/BRAKE**—Minster Machine Co.—OEM Clutch Bulletin 16 gives performance details of fast-acting, synchronized combination.
30. **CHAINS**—Moline Malleable Iron Co.—Choose the right chain-attachment combination from the Designer's Handbook. Many new application ideas.
32. **TRANSMISSIONS, TORQUE CONVERTERS**—Rockwell-Standard Corp—Hydra-Drive power shift transmissions and torque converters offer peak power output for heavy duty equipment. Send for details.
33. **BALL BEARINGS**—Schatz Mfg. Co.—Functional Precision Bearings can cut production costs. Catalog 12 tells how.
35. **REVERSING TRANSMISSIONS**—Snow-Nabstedt Gear Corp.—5 models, 8 and 28 hp, which can reverse under full load. Send for technical data.
36. **ELECTRIC DISC BRAKES**—Stearns Electric Corp.—AC brakes in the 46,000 Series for cranes hoists and winches, offered in sizes 500, 750 and 1000 ft-lb torque. Details in New Product Preview 2-61-B.
37. **FLEXIBLE COUPLINGS**—Thomas Flexible Coupling Co.—All-metal couplings eliminate maintenance and lubrication problems. New Engineering Catalog 60.
38. **MULTI-SPEED TRANSMISSIONS**—Turner Uni-Drive Co.—Available for vertical shaft installation and with reversing. Flexible shaft by order. Write for details.
39. **LAGGED PULLEY**—Van Gorp Mfg.—Turn-Clean rubber-lagged wing pulleys keep belts clean of sticky or abrasive materials. Brochure gives cost advantages.
40. **DRIVE SHAFTS**—H. S. Watson Co.—Shafts need no axial alinement, can handle angles up to 20 degrees, depending on rpm. Details in Engineering Data Bulletin F-15a.
42. **LUBRICANTS**—Whitmore Mfg. Co.—Trial samples of aerosol-loaded open chain lubricant and light or heavy density anti-friction compositions for cartridge guns.
44. **ELECTRO-CLUTCH TRANSMISSIONS**—Western Mfg. Co.—Electro-magnetic clutches change transmission speed and reverse under power. Variety of controls. Send for catalog.
45. **DIHEDRAL COUPLINGS**—Ajax Flexible Coupling Co.—Couplings make possible smooth running angular drives with constant peripheral speeds. Write for performance data.

S-N REVERSING TRANSMISSIONS

5 models 8 and 28 h.p. with power packed versatility



S-N Reversing Transmissions are performance proven, space-saving single units which reverse under full load. Adaptable to the design or redesign of a wide variety of industrial equipment. For technical data write The Snow-Nabstedt Gear Corp., Hamden, Conn.

SPECIFICATIONS

Model No.		5231	5201	5108
Reduction Forward		1.97:1 3.34:1	3.16:1	3.75:1
Ratio Reverse		3.37:1	3.16:1	3.75:1
Power Up To		28 HP	28 HP	8 HP
Max. Input Torque in. lbs.		1000	1000	320
Max. Input Speed RPM		2400	2400	2400
Dimensions	Long	15 11/16"	11½"	9 1/16"
	Wide	14"	13½"	10"
	High	14⅛"	14¼"	10⅛"

SNOW-NABSTEDT
Industrial Division
Transmission Engineers
For Over Half a Century

Circle **35** on Reader Service Card

PRODUCT NEWS

Continued from page 48

sure against the wheel by both shoes. Shoes fit either side, either end up and are self-alining. Top-side adjustment for lining wear and magnet gap, with a built-in adjustment indicator. *Clark Controller Co., Cleveland, Ohio.*

Circle **208** on Reader Service Card

Hydraulic power unit

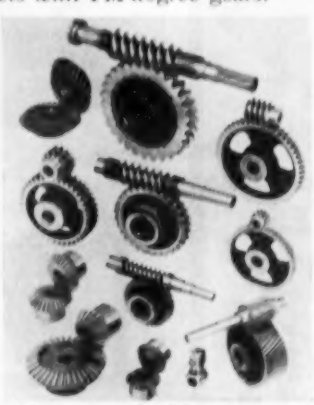
Self-contained control made up of a hydraulic gear pump, relief valve, 3 and 4-way control valves and tank.

Needs only 160 cu in. space when installed. Pump delivers up to 2½ gpm at pressures to 400 psi and shaft speeds to 1800 rpm. Tank has capacity of 0.4 gal with additional oil capacity of 0.4 gal if needed for double-acting cylinders. Requires less than ⅓ hp for maximum pressure operation. Length is 10⅝ in., including shaft extension. *Hein-Werner Corp., Waukesha, Wis.*

Circle **209** on Reader Service Card

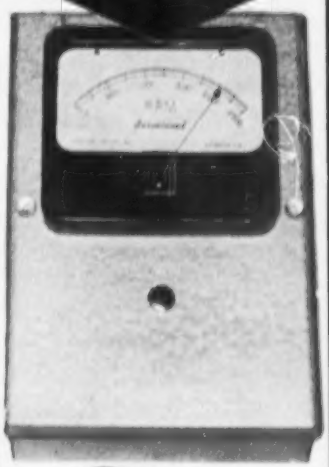
Stock gears

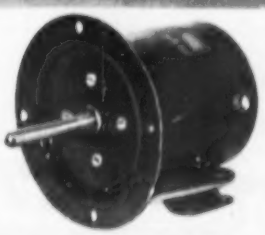
Off-the-shelf 20 degree pressure angle gears interchangeable in sets with 14½ degree gears.



The greater load-bearing area of 20 degree gear teeth provides a greater radius of engagement, takes bigger loads and gives smoother running than 14½ degree types. Available in 3 to 20 pitch in spur, bevel, miter sets (both straight and spiral), helical and worm and gear sets. Various materials—high carbon steel, alloy cast iron, nickel

Servospeed SPEED INDICATING SYSTEM





SERVOSPEED SPEED INDICATING SYSTEM

- **Linear scale 50 Division**
- **DC Generator Self-powered**
- **4½" Meter**
- **Nema 1 Meter Case**
- **Standard Ranges 0-100,250,500, 1000, 2500 & 5000 Calibrated in Percent, RPM, IPM, FPM, YPM.**
- **Rugged DC Generator —5/16" shaft diam.**
- **Base or flange mtg.**

BASIC SYSTEM . . . $69.50

Your application problems will receive prompt attention.

Servospeed
DIV. of ELECTRO DEVICES, Inc.
4 Godwin Ave., Paterson, N. J.
ARmory 4-8989

Circle **34** on Reader Service Card

PRODUCT NEWS

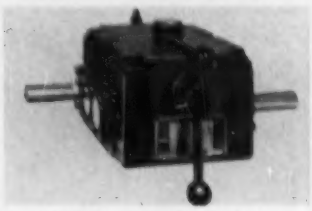
bronze (for worm gears). Non-metallic spur gears available for low-load, high speed applications. *Morse Chain Co., Ithaca, N. Y.*

Circle **210** on Reader Service Card

Reversing transmissions

Permits variety of shaft locations and mounting arrangements.

Latest addition to this line of multispeed transmissions comes in seven standard sizes from 2 to 75



hp. Hinged mounting plate and mounting base are available for compact installation. Bearings and gears are splash-lubricated. *Turner Uni-Drive Co., Kansas, Mo.*

Circle **211** on Reader Service Card

Two-hole flange bearing

Holes drilled for interchangeability with other units.

Housing has a spherical bore so the bearing can self-aline. The bearing is locked onto the shaft by a self-locking eccentric collar. This mates with an eccentric cam on the inner ring, for a precision fit on the shaft. Factory-sealed lubricant. *T. B. Wood's Sons Co., Chambersburg, Pa.*

Circle **212** on Reader Service Card

Reringing sets

Eliminate cylinder reboring on lightweight air-cooled gasoline engines.

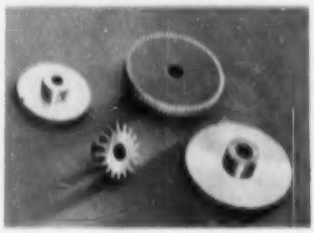
Sets consist of two-piece chrome-faced cast-iron piston rings which have high-strength expanders for positive fit against worn cylinder walls. Rings will effectively seal where combined taper and out-of-roundness does not exceed .004 in. Made in 5 sizes. List price of all sets is $4.95. *Lauson-Power Products, Parts Depot Div., Tecumseh Products Co., Grafton, Wis.*

Circle **213** on Reader Service Card

Stock precision gears

Precision 1, 2 and 3 to AGMA standards.

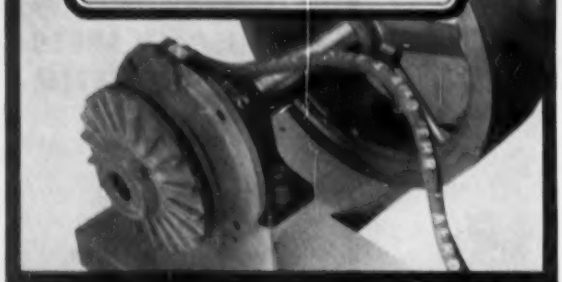
Gears cover diametral pitch ranges that include 24, 32, 48, 72, 80, 96, 120 and 200. Materials are



stainless steel, aluminum, nylon, linen phenolic, in either split or clamp type hubs. *Siamco Div., Tech-Ohm Electronics Corp., Long Island City, N. Y.*

Circle **214** on Reader Service Card

HORTON



NEW AIR-CHAMP BRAKES*

STOP SURE! For stopping rotating parts! PANCAKE DESIGN takes less room—MOUNT ANYWHERE—torque arm or universal. 3 low-inertia models handle up to 4,300 inch lbs. torque. FORCED DRAFT COOLING dissipates heat fast; remote friction surface position guards against heat buildup and brake "fade." Control with static air pressure. Low cost! Ask about "Air-Champ" *clutches!* Write for brochure!

*Patent pending

HORTON MANUFACTURING CO., INC.
1179 15th Ave. S.E., Minneapolis 14, Minn.

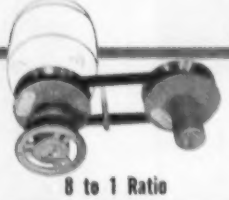
HORTON

Circle **22** on Reader Service Card

GERBING **25 HP Variable Speed Drives**

SAVE 50% compared to enclosed motor drives!

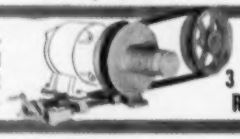
- **Infinitely Variable Speed Change Ratios—Up to 8-1.**
- **Low Initial Cost—uses standard motor or engine.**
- **Maximum Efficiency. V to V.**
- **Compact—Easy to Install.**



8 to 1 Ratio

TYPE W ROTO-CONE—FIXED CENTER DRIVE . . . mechanically operated. Turning the handwheel changes the pitch dia. of both pulleys. May be mounted in any position. HP thru 25 @ 1750 rpm with single v-belt.

No. 1325 ROTO-CONE with Adjustable Motor Base Control. Speed changes made without stopping motor. HP thru 25 @ 1750 rpm.



3 to 1 Ratio

Other size ROTO-CONE Variable Speed Pulleys are available . . . from fractional thru 25 HP. Gerbing Speed Control Engineers are at your service. Write for Catalog 660.

GERBING MANUFACTURING CORP.
ELGIN, ILLINOIS Tel: SHerwood 1-2790

Circle **21** on Reader Service Card

Save $ $ $ $

ATLAS UNIVERSAL JOINTS

Balanced to operate without vibration at all speeds. Short, stubby jaws give maximum resistance to spread. Larger diameter joints fitted with big grease reservoir. Standard alloy steel joints in fifteen sizes for all requirements. Also made in Bronze, Monel and other special metals.

Universal Slip Shafts a specialty.

WRITE for illustrated catalog giving data and specifications.

WEST COAST REPRESENTATIVES

LINK-BELT CO.

Los Angeles
Portland
Seattle

San Francisco
Oakland
Spokane

GRAY & PRIOR

THE
GRAY & PRIOR MACHINE CO.
607 WINDSOR ST.
HARTFORD 1, CONN.

Circle **20** on Reader Service Card

BOOKSHELF

Design of Worm and Spiral Gears

Earle Buckingham and Henry H. Ryffel
The Industrial Press, 1961

Written expressly for those involved in design of worm drives for industry, the book is not suitable for a gear design textbook. The authors have included a feeling of wide knowledge and experience in their problem solving. They show how improved results can be obtained from gear designs, any they offer a design guide to the successful applications of all-recess-action mating surface drives. Recommended for experienced designers only.

Fog Index 11.8

Handbook of Mechanical Wear

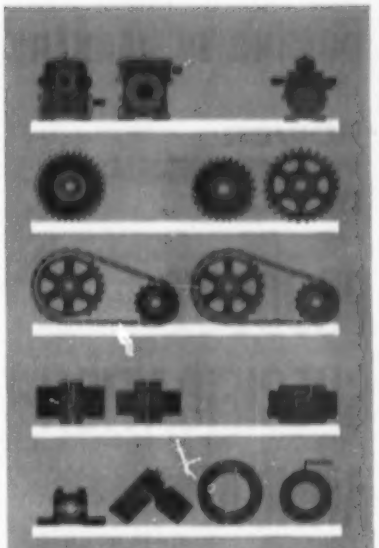
Editors: Prof. Charles Lipson and Prof. L. V. Colwell
University of Michigan Press

A collection of papers by authorities in their fields, grouped into six major categories in 469 pp. Covers fundamental aspects of wear, pitting, scoring; corrosion; abrasion, wear resistant materials and manufacturing processes.

It treats both theory and application in great detail. Typical, is the section on galvanic corrosion. In 24 pp, the authors define their terms, discuss the chemistry, physics and metallurgy involved. The chapter includes a three-page chart on galvanic interaction of metals. Although difficult to read, the book would be useful to practicing engineers and students.

Fog Index 20

The Fog Index number (copyright, Robert Gunning Associates) at the end of each piece is an indication of the book's readability. It has nothing to do with the accuracy or complexity of its subject matter. Generally, a technical book with an index of over 12 is difficult reading. A brief pamphlet on the Fog Index is available from: The Editor, POWER TRANSMISSION DESIGN, 812 Huron Rd., Cleveland 15, Ohio.



INSTANT SOURCE

Charles Bond's large factory and distributor stocks provide an ideal "instant source" for Power Transmission Equipment for today's replacement and design applications. Frequently, the use of a Bond stock component eliminates the need to create a new component—with attendant delay and expense. When required Bond does create special units to your specifications.

Remember Bond—a leader in the power transmission field for three quarters of a century.

AGMA MEMBER

SEE YOUR NEAREST BOND DISTRIBUTOR

or check with Charles Bond Co. for: speed reducers—gears—flexible couplings — sprockets and chains—universal joints—collars —pillow blocks.

Write for Catalog No. 100

CHARLES BOND COMPANY

617-23 Arch Street, Phila. 6, Pa.

Circle **4** on Reader Service Card

COMING IN JANUARY

POWER TRANSMISSION DESIGN

PRODUCT SPECIFICATION ANNUAL

A "keep copy" issue of reference material valuable to designers and users of power transmission equipment.

Includes:

- **more than 30 pages of detailed specification charts**
- **An engineering glossary of power transmission terms**

Charts will show use, materials, sizes available and power and speed ratings for the following products:

Bearings
Gear Drives
Chain Drives
Mechanical Seals
Belt Drives
Electric Motors
Engines
Clutches
Variable Speed Drives
Flexible Couplings

Look For It

JANUARY, 1962

LITERATURE

ON DRIVES AND COMPONENTS

Spin/hard heat treatment

Sprockets, gears, traction wheels, rollers are hardened on the wearing surface only, so the body is soft enough for machining. The part to be treated rotates over a molten salt bath. Only the area to be hardened is immersed. After heating, the part is spun at high speed while it is lowered into an oil or water quench. Advantages: uniform hardness and penetration and no deformation. Folder 2922 graphically explains the process. *Link-Belt Co., Chicago, Ill.*

Circle **300** on Reader Service Card

Shafts and gears

Circular C-114 considers the basic factors of shaft design with emphasis on steel type. Gives a table of comparative factors on the basis of steels and hp ratings, with C-1020 steel carrying a rating of 1.00. Shafts for special jobs in sizes up to 5 in. dia. and 102 in. overall length. Also lists types of gears available. *The Adams Co. Dubuque, Iowa.*

Circle **301** on Reader Service Card

Precision bearings

Catalog 6 starts with a review of production facilities and then gives a very complete compilation of miniature precision-bearing data. Includes new sizes and several new types not previously catalogued (derivative types of the M high speed series and end-cap and integral shaft bearings.) Has a helpful nomenclature section and a section on failure analysis particularly interesting to designers. *Miniature Precision Bearings, Inc., Keene, N. H.*

Circle **302** on Reader Service Card

Chain lubrication manual

Bulletin 1800 shows most methods of oiling a chain, from brushes to completely automatic systems. Gives details of spray oiling and forced-feed lubrication for high-speed chains. Also makes some suggestions for lubricating high-temperature chains, and for chain cleaning. Eight pages, with a data table. *Oil Rite Corp., Manitowoc, Wis.*

Circle **303** on Reader Service Card

All-steel take-up unit

The S-S (slack-side) has been improved with a pinned pivot shaft for high-speed applications and a stainless-steel adjusting nut. Can be fitted with either sprockets, sheaves, toothed belt pulleys or flat-face idlers. Bulletin 55 gives the details. *Industrial Marketers, Ferndale, Mich.*

Circle **304** on Reader Service Card

Bevel gear speed reducers

Catalog No. 420 reviews the advantages of single reduction, right angle spiral-bevel gear speed reducers. Both horizontal and vertical designs. Information includes: formulas for gear speed reducer selection; guide for determining load characteristics of more than 160 applications; and step-by-step examples of reducer selection. Specs, ratings and dimensions cover reducers with input speeds from 100 to 1750 rpm ratios from 1:1 to 6:1 and hp from 0.14 to 336. *D. O. James Gear Mfg. Co., Chicago, Ill.*

Circle **305** on Reader Service Card

Oil bulletin revised

Bulletin 17 on the Solnus Oil line now includes details of Solnus C, a general purpose lubricating oil for very wet conditions. Bulletin covers 10 viscosity grades for once-through or continuous use on plain and antifriction bearings, linkages, cams, gears, compressors, cyl-

The READER SERVICE CARD is on page 50. Even if this copy was not addressed to you, you can still use the card to get information quickly on any of these items.

inders, hydraulic systems and low speed diesel engines. *Industrial Products Dept., Sun Oil Co., Philadelphia 3, Pa.*

Circle **306** on Reader Service Card

Thin-section bearings

Bulletin S-141 lists 90 sizes of Reali-Slim CP bearings for immediate delivery. Conrad deep-groove type, with a one-piece bronze snap-over separator. Sizes from 4 to 12-in. bore with ¼-in. to 1-in. width and cross-section. Bulletin gives capacities, shaft and housing sizes, internal clearances, shoulder diameters, materials and mounting data. Also lists revised prices. *The Kaydon Engineering Corp., Muskegon, Mich.*

Circle **307** on Reader Service Card

Grease sumary

Thirty-two page booklet deals concisely with the basic principles, properties, types and rules, for choice and use of lubricating grease. Includes a section on the effects of additives on grease. *Bardahl Mfg. Corp., Seattle, Washington.*

Circle **308** on Reader Service Card

Bronze parts cost less

Brochure JBL-36, 4 pages, describes the advantages of the Continucast process over sand-casting for quality, low-cost bearing-bronze parts. Lists properties of Continucast SAE 660 and numbers of other SAE bronze alloys made by the Continucast process. *Johnson Bronze Co., New Castle, Pa.*

Circle **309** on Reader Service Card

Expansion fitting

Twelve-page booklet contains a full case history with photos illustrating expansion fitting bearing raceways. Includes tables of expansion coefficients and nomograms for calculating rates of thermal expansion and determining temperatures needed. *Cincinnati Sub-Zero Products, Cincinnati, Ohio.*

Air clutches cut costs

Bulletin ML-199 describes advantages-in-performance of Airflex clutches in drive systems for ball mills, tube mills, pebble mills and rod mills. Gives case history of how a cement mill stopped electrical circuit overload and smoothed start-ups in ball mill operation. *Fawick Airflex Div., Cleveland, Ohio.*

Circle **310** on Reader Service Card

Gear production brochure

This facilities brochure on custom gear and speed reducer production has a condensed spec chart which shows the variety of standard tooling available. No need for expensive special tooling. Illustrations of custom gear products include combination planetary and worm gear reducers, crank gears for a pump, power take-offs, etc. *The Ohio Gear Co., Cleveland, Ohio.*

Circle **311** on Reader Service Card

AC pump motors

Bulletin L-4121A lists two groups: jet pump, 56-frame motors from ¼ to 2 hp; and close-coupled motors, 182 to 254U frames, in ratings to 10 hp. Bulletin contains selection and specification tables, shows various mounting arrangements, speed-torque curves, principle dimensions and illustrates a number of special designs. *Kingston-Conley Inc., Plainfield, N. J.*

Circle **312** on Reader Service Card

Controlled tensioning eliminates shock loading through excessive chain vibration, and horsepower loss through belt slippage.

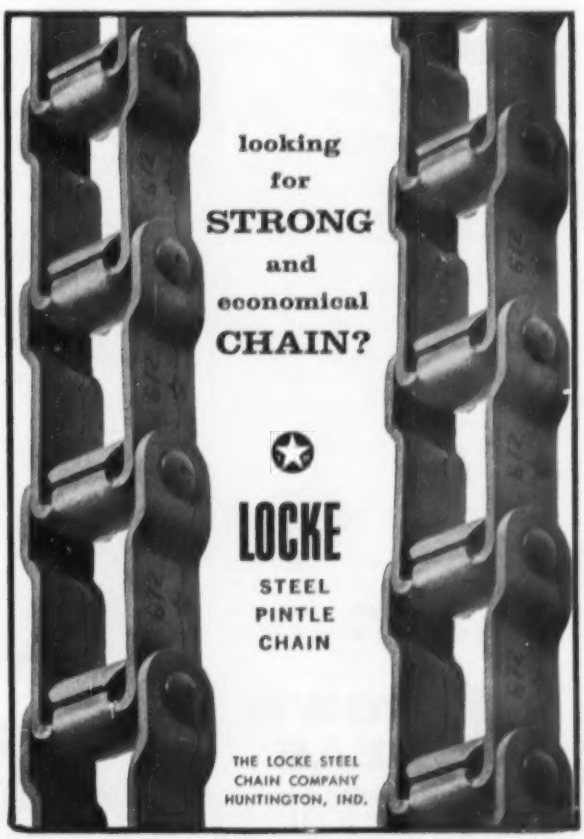
• ROTATING ARM ACTION FOR GREATER ADJUSTMENT
• FULL 360° POSITIONING

A low cost tensioner for single and multiple width drives that is more adaptable to machine frames. *See your Power Transmission Distributor* or write . . .

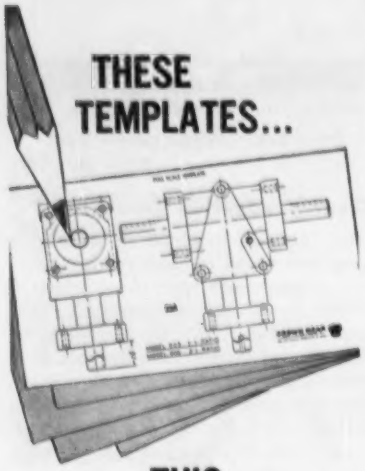
BRONZED BUSHED IDLERS
18 SIZES
AVAILABLE FROM STOCK

BREWER MACHINE & GEAR CO.
1441 N. 2nd St. St. Louis 6, Mo.

Circle **6** on Reader Service Card

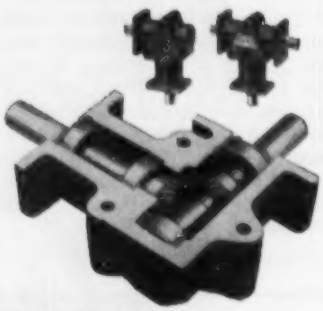


Circle **27** on Reader Service Card



THESE TEMPLATES...

THIS CROWN "PACKAGE"



wrap up your right-angle design problem!

. . . And the transition to the "Package" concept of right-angle power transfer is that simple with this easy-reference template kit. 18 basic Crown right-angle units are shown on six template sheets, each full scale.

WHY spend countless hours on research and drawings? WHY purchase expensive patterns, core boxes, castings, steel and other materials? WHY manufacture fixtures and gages? WHY machine, inspect, assemble and test components?

WHY NOT OBTAIN THE IDEAL SOLUTION TO YOUR RIGHT-ANGLE PROBLEM . . . IMMEDIATELY, AND AT TREMENDOUS SAVINGS?

Your local Crown Gear Distributor (Listed in Power Transmission Design Directory) has the answers . . . and your Template Kit. Call him or consult factory.

CROWN GEAR

320 PARK AVE., WORCESTER 10, MASS.
A Division of Harrington & Richardson, Inc.

Circle 9 on Reader Service Card

MEN

OF THE POWER TRANSMISSION FIELD

Wagner appoints sales managers

The Electrical Apparatus Division of Wagner Electric Corp. appointed Preston F. Ryan manager of its St. Louis sales office and Herbert P. Pillisch manager of its Indianapolis office.

Ryan

Pillisch

Both men were formerly sales engineers in the St. Louis territory. Ryan joined Wagner in 1936 with an M.E. degree from St. Louis and worked for six years in the motor sales department. Pillisch joined the company in 1954. He is an engineering graduate of the Missouri School of Mines.

Assistant manager of Eaton's Cleveland Worm Div.

Cleveland Worm & Gear Division of Eaton Mfg. Co. appointed John R. Dingle as assistant manager. Dingle has been with the Division since 1946. He was work's manager until this appointment.

Dingle

Gilpin

Dana appoint sales manager for U-Joint Div.

Russell L. Gilpin moves up from sales engineer to sales manager in the Universal Joint Division of the Dana Corp. He has been with the company since 1954, having previously worked as a sales engineer with Engineering Reproductions, Inc.

Western Gear has new chief engineer

Raymond W. Whelan succeeds Leo Martin as chief engineer of Western Gear Corp's Industrial Products Division. Martin, retiring after 40 years with the company, will continue as a special consultant.

Whelan started with Western Gear in 1947 as a test engineer. He transferred to sales work in 1951 Previous jobs include sales manager of equipment builders, and of engineered products.

Whelan

McManus

New general manager for Worthington's Pump Div.

Patrick L. McManus has been made general manager of Worthington Corp's Standard Pump Division at East Orange, N. J. His last job was director of marketing services.

Westinghouse fills new planning position

Melvyn Goetz will direct product and systems planning for the consumer products group of Westinghouse Electric Corp. This is a new directorship at Westinghouse and responsibilities include coordinating new product development in all the various consumer product divisions.

JOB MARKET

MECHANICAL ENGINEER

Well-established Richmond firm has permanent position open for trained Power Transmission Sales Specialist. Age 25 to 40. Degree not necessary. Engineering background, practical experience in Sales and Application required. Exceptional opportunity, including good salary, incentive plan, fringe benefits. Contact C. F. Powell, P. O. Box 2279, Richmond, Va.

Classified Advertising Rates: Twenty dollars for the first inch and fifteen dollars for each additional inch or fraction.

Circle **42** on Reader Service Card

TRIAL SAMPLES
Of World-Famous WHITMORE'S Lubricants

OPEN CHAIN LUBRICANT INCREASES CHAIN LIFE UP TO 300%

Penetrates, lubricates, prevents rust. Lubricates deep into chain linkage to reduce friction on pins, rollers, bushings, pressure surfaces. Corrosion inhibitor prevents rust in vital working mechanisms. Lubricates close-tolerance internal surfaces to increase chain life up to 300%. Highly recommended for all climatic conditions to stop rust and corrosion even in salt atmospheres.

Packaged in handy 16 oz. aerosol spray-on containers or in bulk — send for a free trial sample.

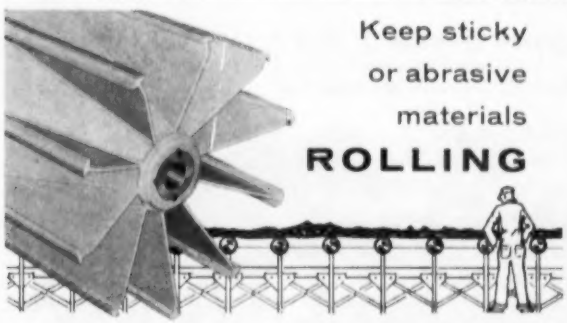
ANTI-FRICTION COMPOSITIONS HAVE NO MELTING OR DROPPING POINT

Packaged in 14½ oz. cartridges for handy application with lever-type cartridge guns for constant protection to roller, ball, sleeve bearings and sliding surfaces in "hot" bearing applications or in areas with high ambient heat. Exclusive formulas have no melting or dropping point; moisture resistant; will not wash out; exceptional metal adherence properties; temperature reducing qualities; high extreme pressure values. Available in two grades. Whitmore's Anti-Friction Composition No. 1 (light density), recommended for high speed, high temperature applications. Anti-Friction Composition No. 2 (heavy density), for low-speed high-temperature applications or loosely-fitted bearings. Specify No. when requesting free trial sample.

68 YEARS OF LEADERSHIP LUBRICATING THE FOLLOWING:

- Open Gears, Dipper Sticks, Cams
- Open and Enclosed Chain
- Speed Reducers
- Enclosed Gear Cases
- Roller, Ball and Sleeve Bearings
- Wire Rope and Cable
- Hydraulic Units, Torque Converters

Est. 1893
THE WHITMORE MANUFACTURING CO.
LUBRICATING ENGINEERS
CLEVELAND 4, OHIO • VULCAN 3-7272



Keep sticky or abrasive materials **ROLLING**

WITH VAN GORP

Turn-Clean® PULLEYS

Van Gorp Turn-Clean pulleys are of all-welded steel construction, with gussets continuously welded to wings and hub to insure maximum ruggedness and top self-cleaning performance under severe working conditions. Dodge Taper Lock bushings permit simple, sure installation. In addition, only Van Gorp offers a selection of 3,000 pulley sizes with four face selections, and custom manufacture to exact specifications. All popular pulley sizes are stocked for prompt shipment. Write for new brochure on 7 ways to cut costs with Van Gorp Turn-Clean pulleys and a free sample of the new "Rubber Lagged" Turn-Clean pulley — the answer to tough drive pulley problems.

VAN gorp MFG., INC.
Dept. PT, Pella, Iowa

Circle **39** on Reader Service Card

FUNK SAVED MONEY FOR THIS COMPANY

On this Dart "Mine Buggy" a compactly-designed Funk transmission provides multiple speed control and doubles as a drop box, thus saving the cost of a 3-stage gear box or a fixed chain drive.

And a Funk Revers-O-Matic Drive, equipped with torque converter, allows the buggy operator to change direction of travel with foot lever only.

Another example of how FUNK MODULAR POWER UNITS can be economically combined — in an unlimited number of arrangements.

Let FUNK solve *your* power transmission problem.

FUNK MFG. CO. Box 577-G, Coffeyville, Kansas

Circle **17** on Reader Service Card

Position Open For

TRANSMISSION DESIGNER

Requires experience in design and stress analysis of gears, bearings, castings, and lubrication for power transmission systems. Graduate engineer preferred. Must be creative.

Submit your personal resume to:

Engineering Personnel Manager

Bell Helicopter Company

P. O. BOX 482. FORT WORTH 1, TEXAS

"An Equal Opportunity Employer"

(Bell Helicopter Company is A Division of Bell Aerospace Corp., A Textron Company)

REPRINTS

The following reprints of feature articles from POWER TRANSMISSION DESIGN Magazine are available:

ELECTRIC MOTORS

Complete coverage of ac and dc types. Includes large Buyer's Guide. From Nov., Dec., 1960 and Jan. 1961 issues. Thirty-two pages.

1-9 copies $1 each
10-49 copies 75c each
Over 50 copies, 50c each

WHY A UNIVERSAL JOINT

Types, operating angles, selection and installation principles. Buyer's Guide, plus three case histories. From Oct. 1961.

1-9 copies, 25c each
Over 10 copies, 15c each

CLUTCHES AND BRAKES

An introduction to both friction and positive contact types. From June and July 1960 issues. Sixteen pages.

1-9 copies, 75c each
10-49 copies, 50c each
Over 50 copies, 30c each

GEARMOTORS

Put the power where the work is—with a gearmotor. From Jan. 1960 issue. Twelve pages.

1-25 copies, 25c each
Over 25 copies, 10c each

NOMOGRAMS

Six nomograms for complete mounting of pivoted motor, base and accessories.

Copies 15c each

Send all orders—enclosing the exact amount in coins or checks—to: POWER TRANSMISSION DESIGN, 812 Huron Road, Cleveland 15, Ohio.

INDEX

OF ADVERTISERS

Ajax Flexible Coupling Co. 47
American Sealants Co., Inc. 47
American Biltrite Rubber Co.
Boston Woven Hose & Rubber Div. 10

Bell Helicopter Co. 58
Bin-Dicator Co. 49
Charles Bond Co. 53
Brewer Machine & Gear Co. 55

Cincinnati Gear Co. 17
Cone Drive Gears
Div. of Michigan Tool Co. 31
Crown Gear Co. 56
Cullman Wheel Co. 9

Dalton Gear Co. 16
Dayton Rogers Mfg. Co. 48
Diamond Chain Co. 13
Durkee-Atwood Co. 4

Fawick Airflex Div.
Fawick Corp. 7
Fort Worth Steel & Machinery Co. 47
Funk Mfg. Co. 57

Gates Rubber Co. ..... Cover II
Gear Specialties, Inc. 11
Gerbing Mfg. Corp. 52
Gray & Prior Machine Co. 53

Horton Mfg. Co. 52

Janette Motor Div.
National Pneumatics Co., Inc. 43
Carlyle Johnson Machine Co. 15

Link-Belt Co. 38
Lima Electric Motor Co. 32
Locke Steel Chain Co. 55

Maurey Mfg. Corp. 58
Micro-Precision Gear & Machine Corp. 45
Minster Machine Co. 35
Moline Malleable Iron Co. 18

Olme Precision Products 49

Rockwell-Standard Corp. ..... Cover III

Schatz Mfg. Co. 42
Servospeed
Div. of Electro Devices, Inc. 51
Snow-Nabstedt Gear Corp. 51
Stearns Electric Co. 6

Thomas Flexible Coupling Co. 14
Turner Uni-Drive Co. 48

U. S. Rubber Co. ..... 2 & 3

Van Gorp Mfg. Co. 57

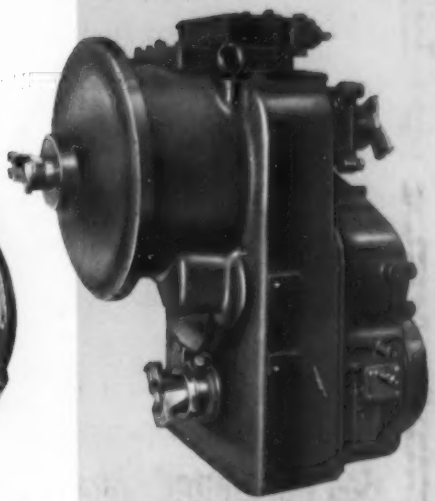
H. S. Watson Co. 12
Western Mfg. Co. 49
Whitmore Mfg. Co. 57

HYDRA-DRIVES
BDB
Transmission

- Four speeds forward and reverse.
- Full power shifting.
- For equipment up to 175 h.p.

HYDRA-DRIVES
Torque Converter

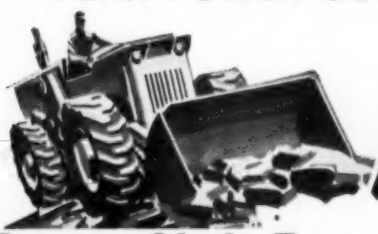
- 3-to-1 torque multiplication.
- Available separately, or with Hydra-Drives Transmission.
- For vehicles up to 500 h.p.



HYDRA-DRIVES
CDB
Transmission

- Four speeds forward and reverse.
- Power shift in each range both forward and reverse.
- For equipment up to 250 h.p.

PEAK POWER OUTPUT FOR HEAVY-DUTY EQUIPMENT...



Hydra-Drives®

Power Shift Transmissions and Torque Converters

Rockwell-Standard's Hydra-Drives units make hard work easy for heavy-duty equipment. The result . . . smooth, efficient, economical operation. A torque converter and 4-speed transmission in one compact package, the Hydra-Drives Power Shift Transmissions have been proved in hundreds of vehicles. They eliminate engine lugging and heavy shock loads. A 3-to-1 torque multiplication makes starting fast and effortless – even with heaviest loads.

Just a flip of the operator's lever accomplishes power shifts without interruption of the power flow. Automatic features of the converter and ease of power shifting simplifies operator training and lengthens vehicle life.

With four speeds forward and reverse, the Hydra-Drives Power Shift Transmissions are ideally suited for vehicles which must travel in both directions during a normal work cycle.

Hydra-Drives Torque Converters are the simplest, most efficient made. They can be matched with any transmission for easier, more efficient operation.

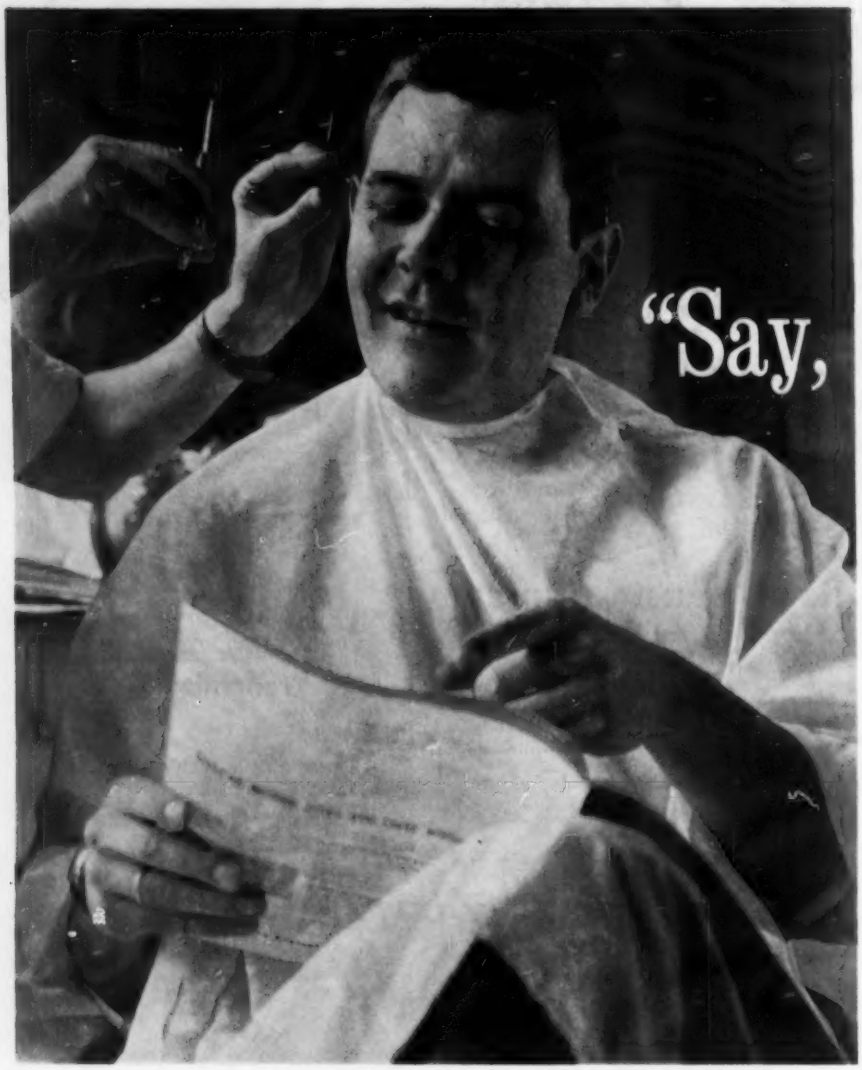
Another Product of...

ROCKWELL-STANDARD
CORPORATION

ROCKWELL R STANDARD®

Transmission and Axle Division, Detroit 32, Michigan

Circle **32** on Reader Service Card



"Say, I can sure use this idea"

IDEAS . . . that's what POWER TRANSMISSION DESIGN is here for. It is written by power transmission specialists for power transmission specialists: men like you. POWER TRANSMISSION DESIGN is edited to solve both original equipment and in-plant design and maintenance problems.

To build this hard-working editorial package, staff members travel regularly. They cross the country, talking with the people and studying the developments that make news in the power transmission field

You get the benefits. Between these covers you'll find ideas you can use. Design ideas: they show you what other fellows are doing that you may want to copy. Product ideas: they show you the latest in equipment available to you.

Why not check the contents page right now. There are bound to be several articles you'll want to read. And, for full details on any item described or advertised in this issue, just use the handy Reader Service Cards.

POWER TRANSMISSION DESIGN

The First Magazine of Power Transmission

Published by The Industrial Publishing Corporation

812 HURON ROAD • CLEVELAND 15, OHIO • SUPERIOR 1-9620

OFFICES: NEW YORK • CHICAGO • LOS ANGELES • LONDON

FC FRANCHISE CIRCULATION — *Franchise Circulation gets magazines to the men who buy*

DISTILLED WRITING — *Distilled Writing gets magazines read*